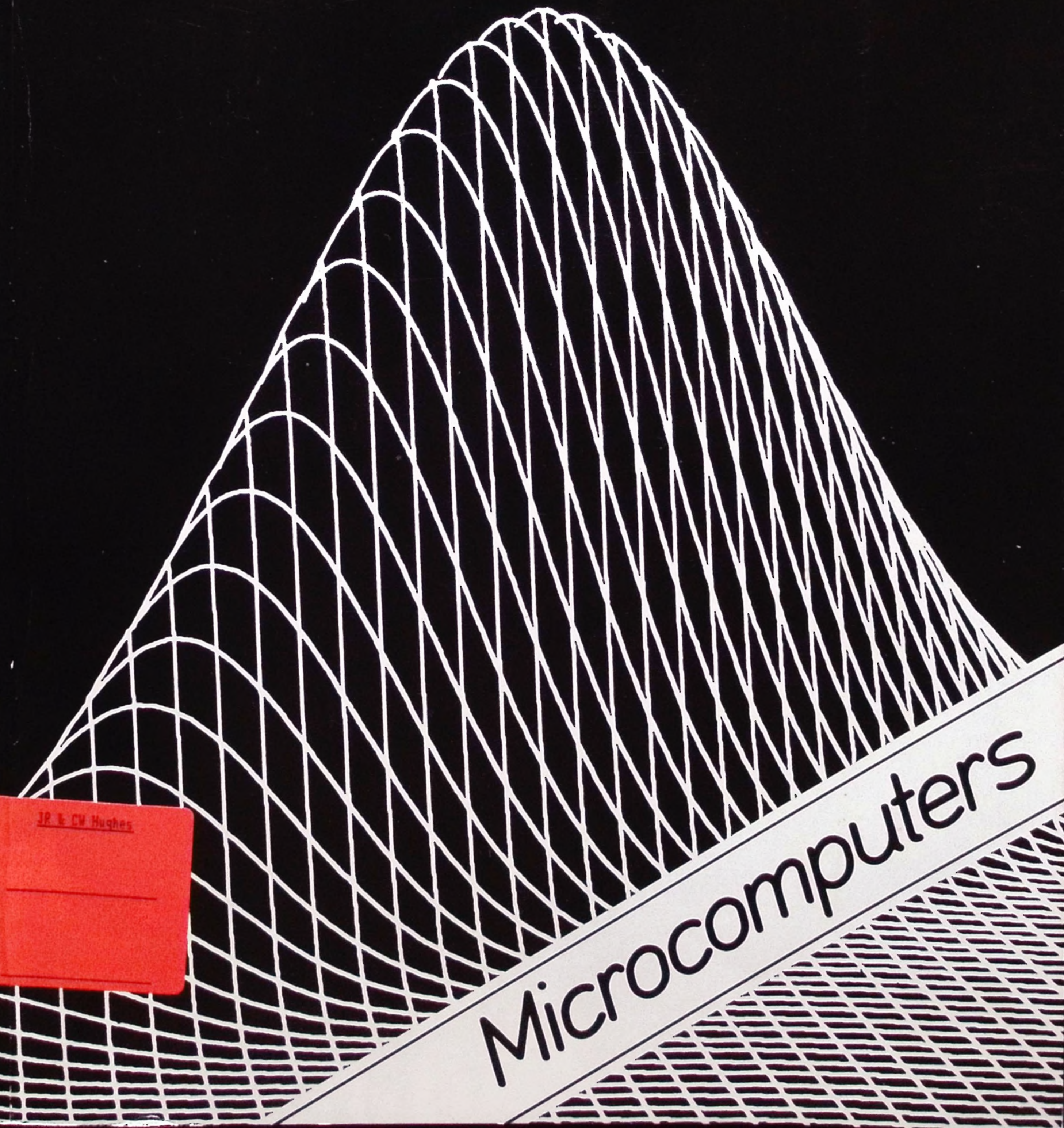
Greater Manchester

PRIMARY CONTACT

Special Issue Number 3



Microcomputers

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EDITORIAL

Special Issue Number 3

Welcome to our third special issue and our second edition of "Microcomputers". As in the first edition, our aim has been to gather together and disseminate as much relevant experience on the impact of microcomputers on the primary school as we could find. We have again included articles that reflect some current concerns, debate some of the issues involved and consider some of the future implications. Our first edition of "Microcomputers" clearly met a need as it was sold out rapidly. If you wish to have your own copy of this issue, our advice must be to get your order in quickly. You will find the necessary details on the inside of the back cover.

We believe that this issue provides considerable evidence that teachers and researchers concerned with primary education, and the children themselves, are rising to the challenge of the microcomputer with enthusiasm. This contrasts starkly with the depression which is settling around them. The British microcomputer industry is in crisis; the "Micro in Schools" scheme has faded into the past; MEP is awaiting its fate. Ways *must* be found to maintain the momentum generated in our primary schools to utilize the microcomputer and to sustain the professional energy released by the specific allocation of funds to provide the new technology. LEAs will no doubt do what they can, even though they have many problems of other kinds. Organisations like MAPE, MUSE and BLUG will continue their sterling efforts to provide focal points for development and debate in this area, as well as doing what they can to disseminate and provide assistance to their members. However, there surely is a danger that many teachers may interpret the government's withdrawal of direct subvention as confirmation that the microcomputer is a passing phase. Money *must* be made available to encourage teachers to explore the relationship between the microcomputer and the primary curriculum and good primary practice. Schools *must* be able to replace their first generation micros with more powerful machines and to purchase the increasingly sophisticated software packages that are likely to emerge.

Financial resources must be made available to keep schools abreast of technological change and innovation. Today's curriculum is hardly likely to be relevant if it is not influenced by tomorrow's technology. Or do we want schools that are museums of our technological past?

It is also desirable that there should be an independent national body that is charged with the task of evaluating the new technology and developing its educational uses. This body would also have the role of collating and disseminating experience in this area. It might also provide in-service training in aspects of the new technology which LEAs and other bodies were not able to provide. This body could be housed in one centre and unlike MEP would not require a regional infrastructure, although it might wish to keep some of its employees in the regions to ensure that contact was maintained with LEAs and schools.

We cannot end this editorial without saying what we said finally in our last edition of "Microcomputers". We are, again, enormously indebted to our many contributors for their professional generosity. To each of them, we would like to extend a personal thank you on behalf of our readers. We would like also to acknowledge the journals and publishers who responded equally generously when their permission was sought to reprint articles. On this occasion we are also grateful to MEP and CISTEL who have provided sponsorship, thus enabling us to print more copies at a more reasonable price. Incidentally, no matter what lies ahead for MEP, we would like to thank the many wonderful people in that organisation who have made a tremendous effort over recent years to meet the needs of the profession in this fast changing field.

If you would like to make suggestions or offer an article for our next edition, please write to us.

Primary Contact

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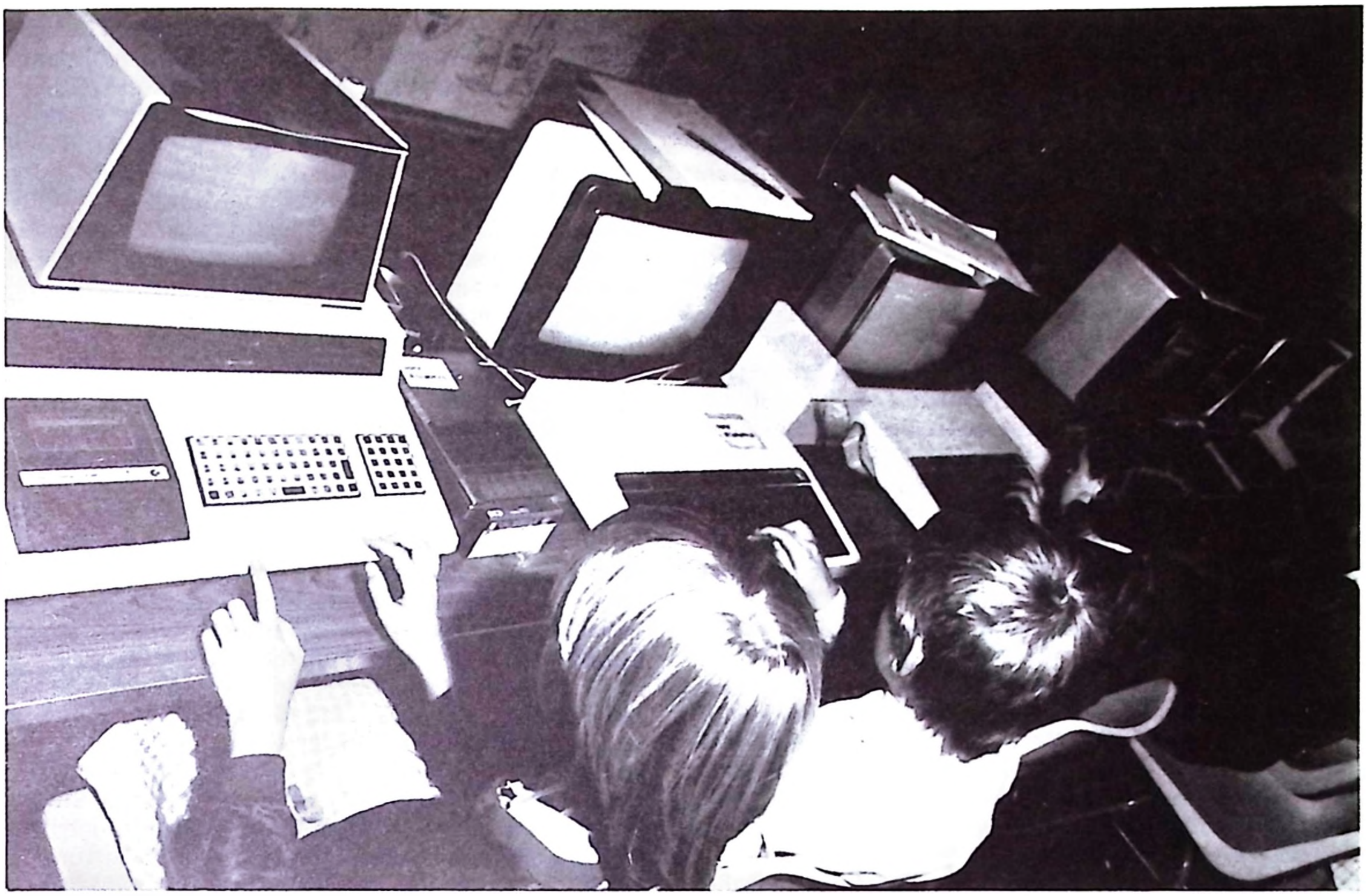

The Past Two Years of Children Using Computers by Dr. David Wharry

Since the first special issue of the Greater Manchester Primary Contact (Special Issue Number 2, 1983), we have seen some developments in the use of micro-computers in the primary school, and of devices based upon them; but the period has mainly been a time of consolidation and development rather than a period of radically new ideas. The organisation of courses and centres for in-service and pre-service computer familiarisation has proceeded apace, and new materials developed by such organisations have started to arrive where they should do most good. On the hardware side we have seen many new microcomputers presented in the High Street shops, and also we are beginning to see such drastic reductions in price for items such as disc drives that schools are now beginning to buy them. Perhaps the phrase should be "PTAs are showing their support".

Let us deal with the production of materials for use in schools and the provision of INSET courses. The Microelectronics Education Program (MEP) has paid particular attention to the primary sector by setting up the National Primary Project. This has been in existence for over a year and has already produced some excellent materials. The aim in setting up this project has been to provide materials directly for helping along the process of teacher education. Thus the target is really institutions for teacher education, training colleges and university departments of education and such like, which provide facilities for pre-service and in-service courses, but since most of the material is free from copyright it should find its way into schools when the teachers have finished their courses.

The team is headed by Anita Straker, formerly an Adviser in the Wiltshire Education Authority, and she is aided by two project assistants, and also technical and secretarial assistance is included in the team based in Kings Alfred's College, Winchester. During 1984 the Primary Project has produced and distributed the following materials:

The Mary Rose Pack

The purpose of this pack is to stimulate discussion about the role of the micro as a focus for a topic leading to work spread across the primary curriculum. It consists of:

★ tutor guidelines with suggested course sessions
★ overhead projection transparencies and notes
★ mounted photographs and slides of children's work
★ slides of the raising of the Mary Rose
★ an audio tape, and articles for background reading.

Primary Maths and Micros

This was distributed during the Summer of 1984 and consisted of:

★ tutor guidelines with suggested course sessions
★ a disk of software illustrating how the micro can be used to aid young children's learning of mathematics

★ program notes concentrating on practical classroom activities
★ a tape/slide presentation on maths across the curriculum
★ the Ladybird/Longman computer publication, the INHABITANT
★ a list of software now available to support maths teaching in primary schools
★ articles for background reading

Language Development and Micros in the Primary School

This package was being prepared while this article was being written, and by the time you read this it should be already in the hands of the tutors, lecturers, advisers and regional representatives of the National Primary Project who will chiefly be responsible for using it with teachers and distributing it to schools. The package consists of:

★ tutor guidelines with suggested course sessions
★ software disc exemplifying software for young children's development in language
★ program notes concerning practical classroom activities
★ a video showing the quality of children's spoken language that can arise from the judicious use of the micro
★ GRANNY'S GARDEN, a commercially developed program (for demonstration only)
★ software list for language development programs
★ background articles

The quality of these packages is outstanding, and in the hands of interested and capable teachers the programs disseminated by the project will surely have a beneficial effect on the use of micros in the classroom. The project still has another year or so to run, and during that time it is expected that further packs will be prepared and distributed. The interests of the project are not confined solely to such programs as those noted above, LOGO and Control Technology also figure prominently in the project's future plans, and neither are the interests of the infants overlooked.

The other aspect of the project's work is to provide courses of familiarisation and practical experience in the use of microcomputers with children for advisers, lecturers and others with a similar function in teacher training. The remarkable aspect of the project here is that it pays the whole cost of the courses and so becomes a very real help to local education authorities faced with an enormous in-service training problem.

Picking 'the wheat from the chaff'

The amount of software that has become available during the past couple of years is truly staggering – one only has to glance at such publications as Educational Computing each month, and read the summaries of programs available, to appreciate that in a general discussion of the progress of computing in the primary classroom it is impossible to pick out the wheat from the chaff or to make recommendations. Probably the best advice that anyone can give is to take note of what friends and colleagues say about software they have personally used and if possible to ask them for a hands-on with it before deciding to buy. In this connection one feels compelled to sound a bit like a do-gooder and urge the reader not to pirate software that is loaned. By all means borrow it and see if it is what you want, but if you decide that it would work well in your classroom please do make the effort to pay for a legal copy! If too many people say "It doesn't make any difference if just I do it" then the overall effect is to persuade professional software writers and producers to move out of the profitless field of educational computing and leave the game to cowboys and pirates. It is only ourselves who will be to blame if the supply of decent software eventually dries up.

Perhaps there is another way – we should try to persuade the government to continue funding the M.E.P. and to extend the funding so that good software will be written which should then be distributed gratis to schools and teacher training establishments. While getting things off my chest let me also make a plea that projects funded by public money ought to be dissuaded from the practice of selling the completed programs and documentation to commercial firms for distribution. It is surely much better to do as the National Primary Project is doing and distribute most of its software to regional centres with free permission to copy anything other than the few good commercially produced packages (e.g. INHABITANT) that are included as examples for demonstration only. It does seem very foolish to spend tens of thousands of pounds of public funds developing a program only to have to spend even more when the end-users have to buy it from commercial publishers. Granted, a professional distribution network could be an advantage, but if such is better than the hand-to-mouth private copying noted above, then why not let it be another MEP project supplying without cost to the end-user. An unexpected by-product of the MEP has been the great interest evinced overseas by other education authorities and if the government really must claw back some profits from the production of good software, let it be by charging fat fees for licences to overseas users.

The proliferation of home micros

Any Saturday morning's shopping expedition will disclose something these days not seen when GMPC special issue 2 was published, and that is the proliferation of cheap, high quality micros for home use. In the conclusion of the first article in that earlier issue we noted that "developments on the near horizon such as colour and high resolution graphics in a 64 kilobyte microcomputer at less than £100 make our present equipment obsolescent". Perhaps we were carried away slightly, but to look around and see the various Commodore machines, the Amstrad, the MSX machines and so on at the lower end of the cost scale and things like the Macintosh, IBM and others at somewhat greater prices, all easily available in the home market, makes one realise that in a very brief space of time microcomputers have developed in scope, reliability and economy quite amazingly. It is this public awareness and the availability of inexpensive hardware which has caused many a PTA to present its school with a micro, and sometimes several. One is no longer surprised on visiting a junior school to hear "our computers" referred to in the plural. Neither is it uncommon to hear of infants schools making regular use of computers, and not just those favoured schools which have had some sort of project aid given to them to help develop and evaluate software for infants.

Is our present equipment obsolescent even now? The expert computeer might well be tempted by thoughts of 128K memories of some of the more modern machines and say "yes", but with some 80% or so of schools having bought the BBC micro and an incredible amount of effort having been spent on producing good software for the machine, it seems very unlikely that schools are going to be able to afford to change over to a new machine for several years yet. This, of course, could be one of the penalties that a country that has come to lead the field in educational computing might have to pay, that others who have held back may profit from our experience and start off with a new generation of computers in their schools. However, that day is not quite with us yet in my opinion, and it may be a few years before the cheapest of the 128K machines has lost all its bugs and gained some useful school orientated software.

The move to disc drives

The main development in schools as far as hardware is concerned appears to be the purchase of disc drives. At an Acorn User Show during the summer the author was able to purchase for under £600 a BBC model B with disc interface and a double sided switchable 40/80 track single disc drive. By searching the Micro User magazine it is possible to discover 100K disc drives for less than £100, although the disc interface is not included in this price. So really the speed, convenience and reliability of disc drives is now within the grasp of a primary school. All that remains is to persuade software suppliers that their programs should be written with both cassette and disc users in mind. Nothing is more frustrating for the disc user than to send away and pay money for a program like, for example, the Acorn/Which Weight Watchers program and then to discover when it arrives that, although it can easily be made to run from a disc, when it is running it does so in the cassette mode and any saving or loading of data must be on a cassette although the program itself was actually loaded and run from a floppy disc. Another example the author has encountered is a well known light pen add-on for the BBC. It can be made to run in part from disc, but then the user finds that the next part has to be loaded from cassette or saved to cassette. If users who have invested in a disc find this sort of thing happening they must send the cassette back with the demand that a program is supplied on disc suitable for total running from disc with all files being able to be saved to disc and so on. Users should not be fobbed off with half and half programs.

Any software firm worth its salt like, for example, Applied Systems Knowledge, automatically offers to supply either a cassette or a disc based version of all their programs and moreover undertake to supply a disc based version for a moderate extra cost if users upgrade their computer in the meanwhile from cassette to disc. Users should insist on a refund of their full purchase price if software suppliers are not prepared or able to act in this manner. Simply return the goods with the written comment that they are not of merchantable quality and request a full refund of the purchase price – it would not be unreasonable also to demand refund of postage costs as well, although perhaps that might not be worth the hassle!

Other enhancements for the inside of the BBC micro have been designed and are offered for sale by many different companies to help users obtain greater value and flexibility from their micros. One problem concerns the very small amount of memory space left for the program if it uses a high resolution graphics screen – this can be overcome by the use of such extra electronics boards as the Aries and the Raven. But beware when thinking of purchasing such a board – enquire from the vendors if they have checked that it will be compatible with the software that you intend to use with it – sometimes certain things, especially some word processor ROMs, have been badly written and refuse to work properly with these extras.

Giving your micro more memory room

We have just mentioned the word ROM. Much interest has been shown in these chips recently and many have been produced which have specially written software permanently engraved in them electronically. These are really another way of giving your micro more memory room. The ROM program exists in a particular spot in the microcomputer's memory that does not take up the valuable space into which ordinary programs from cassette or disc are loaded, and while they are in the micro you can take advantage of their special properties without having to load something extra. For example we have wordprocessors like Edword, View, Wordwise and Scribe, and utilities like Disc Doctor and Toolkit. Also there are ROM programs that enable you to file, sort and retrieve data, and others which act as spread sheet calculators. These all come as chips which are fitted inside the machine. The only trouble is that the original design of the BBC micro only left room for 2 or 3 to be fitted at any one time, and so a large number of extra devices have been produced to enable one to fit and use several ROMs without continually having to remove the case top of the micro to exchange ROMs.

The latest in these ROM extensions actually gives you space where a magnetic copy of the ROM can be loaded from disc into a RAM and then work in the ROM space just as though you had actually fitted a solid chip in the slot. These boards should really be called Paged RAM/ROM boards, but more popularly they are known as "Sideways RAM". Perhaps the next generation of micros in schools will have such a big chunk of ordinary memory that these special devices and all their added complications will not be needed to give the micro its full power. The first British model of these machines has already been marketed with 128K memory as standard, but at present it is so new that really there is no worthwhile software written for schools use; and, additionally, its fast, continuous-loop tape drives seem to be very much more expensive to run than the more normal disc drive. No doubt in the next couple of years users in school will come to demand cheap reliable disc drives as standard equipment, just as cassettes seem still to be standard equipment at present.

Micros and technology

Various other bits of hardware concerned with the teaching of technology have become available which might interest some teachers in primary schools. Milton Bradley, the makers of the well published Big Trak, have recently brought out in the U.S.A. a kit called ROBOTIX. This is a kit of parts made in ABS plastic and which fit together with hexagonal sockets. The parts include small motors, gearboxes and axles, etc., and walking robot-like constructions, vehicles, cranes and other machines can be built according to a child's fancy and ingenuity. At present the machines so constructed are controlled by a wire leading to a 5-key hand control box, with batteries supplying the power. There seems to be no reason why an interface should not be developed which would allow a microcomputer to take over the control function so producing a genuine and cheap school constructed robot. This is, of course, this author's pipe-dream; at present these kits are only available in the States, and we hope that Milton Bradley will soon release them in this country, and also that they will come up with an interface suitable for the BBC micro.

Some other bits that have been available for some while are the Meter Box and similar interface boxes at very reasonable prices from the EARO (Ely Area

Resources Organisation), Back Hill, ELY, Cambridgeshire. At some £20 each, including program cassettes and ideas sheets, these seem to be a very worthwhile add-on for the micro for those interested in using it for science related activities in the primary school. A further device that has become available is the "IN CONTROL" kit. This consists of an interface box and programs which can be used in conjunction with the technical LEGO kit in a very much more flexible way than the BBC Buggy – at least that is this author's opinion, having had a very limited experience of both systems. There is a plethora of interfaces that have become available at quite reasonable prices; we might mention the Minor Miracles interfaces which enable the BBC micro to be programmed to switch on and off electrical devices, although the user will need to be fairly well prepared to do a bit of home programming if he or she wants to use one of these kinds of devices. The latest of this kind of device to come to the writer's attention is made by Deltronics of Llanelli, Dyfed, and we understand that, unlike the Minor Miracles, this firm have produced an interface box designed particularly with primary schools in mind.

Programming languages

Finally to return to software, it would not be right to leave this general review of where computing stands in 1985 without mentioning programming languages. The one, apart from structured BASIC, that seems to have caught everybody's interest at the moment is LOGO. Originally LOGO was designed in the Massachusetts Institute of Technology (MIT), and those who have read Seymour Papert's "Mindstorms" will appreciate the idea behind the use of LOGO as a "mind developer" for children. Unfortunately many of the adaptations of this language which have come on the market during the past year have only implemented one, albeit very attractive for young children, feature of the language, and that is Turtle Graphics. The Turtle was, and still is, an expensive electromechanical, self-propelled vehicle that can drag a pen over large sheets of paper spread on the floor and leave a track of where it has been. The Turtle is controlled through the language LOGO from a computer to which it is attached by an unbilical cable. Naturally teachers of young children will recognise the essentially concrete nature of this device, and will appreciate how much more real such a device is to young children who are learning to handle a computer for the first time.

Turtle graphics is the screen representation of what the turtle is doing on the floor. In some of the cheapjack versions of LOGO that is all you get. The designers have been obliged to leave out all the really important bits of the language concerned with list processing, numbers and words, because the BBC micro in its unimproved state, just has not enough memory to contain this new language. What is needed to get the full language is another ROM, rather like the one that contains the BASIC language commonly used for most programs sold for the BBC. Currently there seem to be three firms producing a full LOGO – these are Acornsoft, Logotron and the Open University. So if you are one of those teachers who believes that children can best be prepared for the brave new technological world of tomorrow by actually programming the beast rather than just using it, then you should give very careful consideration to the idea of introducing your young potential programmers (and yourself, of course) to one of the full implementations of LOGO. You should find that it will do anything that BASIC can do, and do it in a much logical and readable manner. Courses on using LOGO with children should be available locally, and if they do not appear to be then it is sure that one of your local bodies will be pleased to run such a course. You will only have to suggest it to them.

Finally I really must apologise to all readers who have the 480Z or the Spectrum in their schools – anyone reading this review would be forgiven for thinking that in my world those machines do not exist – they do, of course, and the Department of Industry made sure that anyone who wanted one could have it on the same terms as, and instead of, the third recommended machine, the BBC micro. Moreover they have made sure that all teacher training institutions have these machines available for all teachers, both pre- and in-service, to practise with. LOGO, Structured BASIC, and all the good educational programs similar to those produced for the BBC are available for both these machines and also control technology equipment, and they are still being produced by the MEP; so if anything that has been described or commented on in this article seems not to apply to the machine you have I can only apologise and ask you to contact your adviser, or if conveniently near, your regional MEP centre, for advice, information, instruction or hands-on experience.

Innovating and Resisting the two sides of CAL

by G Heywood

University of Lancaster

The arrival of the microcomputer in primary schools is unique as innovation on a number of counts. Never before has there been a 'system-wide' innovation which would have such immediate effect on both content of curriculum and on how that curriculum might be encountered in the classroom. The movement towards Programmed Learning in the 1950's perhaps provides the nearest parallel. The differences between Computer Assisted Learning (CAL) and Programmed Learning, in large part their degrees of interactiveness, may point to

one of the reasons why the latter was resisted in our schools. System-wide innovation is bound to cause a great deal of discussion, debate and dissent among educationalists in both informal and formal settings. What are educationalists saying about CAL? Is their dialogue unintelligible to those without a glossary of the latest technical terms? Are they mulling over the shortcomings of BASIC as a suitable programming language for the junior school? On the whole I think not. Conversations I have heard (and in the course of my research into the usage and uptake of CAL in junior schools I have kept within ear-wagging distance of many such conversations over the past 12 months) tend in the main to be concerned more with 'hands off' experience as much as 'hands on', as tales of variable implementation abound. Some schools may well be running fund-raising activities for their second, third or fourth micro but others of similar size and from the same area would not know in which cupboard it was locked away last term.

The poor uptake of technology

Accounting for this variation in uptake would take too long to cover adequately here and would necessitate analysis of internal and external pressures of resistance and innovation support which make up the dynamic of any particular institution and its propensity to innovate and develop the curriculum. Instead, I wish to concentrate on one issue which perhaps has been overlooked but may be a contributing factor to resistance to CAL. Throughout the history of educational media (and too little exists in written form) what is strikingly clear is that items of technological hardware have been largely underimplemented and often inappropriately used in schools especially in the primary sector. Keith Hall (1971, p628) writes that 'none of the techniques (of educational technology) have lived up to their early promise in contributing to the instructional program of schools.' He goes on to assert that it is a lack of learning theory undergirding the use of the devices that has led to their poor uptake. Coburn (in Coburn et al 1982, p181) sees 'the failure of education to use television in schools to approach the effectiveness originally predicted' as especially noteworthy, 'particularly in the light of its influence on our culture and learning through home viewing.' Of course, there can be no 'legislation' for use in classroom practice but the waste of good resources must not go unnoted.

What then of the micro?

What then of the micro? Will there be similar resistance at work to deter its potential use in primary education? To answer this, the nature of the CAL experience must first be broken down, for CAL involves not a single innovation in my opinion but a combination of two very differently implemented innovations: the software and the hardware.

On the one hand the introduction of the hardware was decided without very much discussion at school level. The Department of Industry's offer to pay a large proportion of the cost of the micro was an offer too good to refuse (or repeat ?). Coupled with this was the tidal wave of new technology that was sweeping easily through commercial and business life and then, with wider applications, toward other institutions notably the home and schools. It was only a matter of time before the waters of information and computer technology were flooding into primary and infant schools. The moral and educational obligation to give children experience of microcomputing was an imperative which schools had no right to ignore. The machines duly arrived, were unpacked and plugged in. With the over-head projector or with the language laboratory there would be no need for the next question that staff might ask as they watched the impatient cursor flashing for a command. 'What are we going to do with it?' was the question.

The 'MicroPrimer' software package which came with the machines gave some ideas, but was intended, by and large, as an introduction to the computer's capabilities and to provide the first part of a software collection on which it was envisaged schools would then build. The software is the second side to the implementation of CAL. Whereas the hardware was imposed on schools ('change without choice' some called it although it need not lead to 'change' of any sort), the software used in classroom CAL must necessarily fit into or adapt the existing curriculum to suit it if it is to be successful. Schools simply using the MicroPrimer pack with no intention of adding to or developing micro software are not only limiting the development of CAL but also running the risk of 'tissue rejection' which may occur when the novelty of the computer innovation wears off. On the other hand, those intending to build up a software library must implement (and beforehand go through variable degrees of decision-making processes) in such a way as to ensure its optimum success. Much has been written about participative decision-making (see particularly Bates et al 1974, Houghton 1974, Stufflebeam et al 1971) and of the concept of the 'continuous staff conference' (Richardson 1973) where teachers and head, along with all other interested parties felt to be able to contribute to continuing development take part in making decisions.

But this paints a rosy (and early 1970's) picture. The continuous staff conference is one which takes place among staff accepting the initial need of the innovation. Perhaps the position is different with CAL. On the one hand it would be an obvious development, having accepted the micro's possible contribution, to look at and innovate across the curriculum from a Problem-Solving perspective (P.S. involves assessing needs, selecting from options, trial periods, initial evaluation, extended trial, secondary evaluation, implementation and continual re-assessment) – but in reality, many resistance features stand as obstacles in the way of such straightforward development. On such rocks of resistance have foundered many a new heralded educational resource. CAL could be more prone to such resistance than most previous innovations.

Resistance may occur in one (or more) of the following ways:–

A *Organizational constraint:*

i) The innovation may not be compatible with the educational aims of the school.

ii) Teacher conservatism – tried and trusted methods prevail.

iii) Teacher traits. Examples from Harris (1975 p206) are:
an uncomplicated view of causality, an intuitive rather than rational approach to education, an opinionated rather than open-minded stance etc., or two of Doyle and Ponder's (1977) teacher typology – Stone-Age Obstructionist or Pragmatic Sceptic.

iv) Organizational conformity – organizations have a built-in tendency to stability especially when displaying hierarchic or highly demarcated features and although this may apply more in the secondary sector, primary schools are susceptible to it.

B *Financial constraint:* Schools quite simply may have no extra financial resources to spend on building up a software library. Other resource areas may take priority.

C *Instructional constraint:* Teachers may be resistant to the idea of CAL as such. Olson and Bruner (1974) have contributed to this debate by questioning the micro's tendency to provoke 'mediated learning' whereby the CAL experience *could be* a substitute for direct experience (enactive learning). Maintenance of the instructional status quo would further reinforce any such feelings that the computer might present inadequate learning environments for primary school children.

No matter what the merits of such assertions, fears or phobias, there is a great danger in ignoring them as possibilities. Eicholz and Rogers (in Miles 1964, p306) drew up a thorough list of potential rejection responses which may serve to draw in many of the issues above. They see possible rejection through a) ignorance (the innovation is unknown), b) default (there is no interest in it), c) maintaining of the status quo, d) societal mores (the innovation is educationally questionable), e) substitution (the teacher would rather choose another innovation), f) fulfilment (already happy with the existing methods), g) experience (having tried it, found it wanting).

It seems obvious therefore, that many factors of resistance need be avoided or overcome if CAL is to make a valuable contribution to the primary school curriculum. Why then make an issue out of the 'two sides of CAL'? Surely resistance will be the same for both hardware and software? I think not, and it may be that staff need to look at specific potential problems with each. Features of both are set out below:-

	Hardware	Software other than 'MicroPrimer'
Developer	Government funded computer industry	Various – some commercial, some educational eg ITMA.
Cost to schools	Half proportion	Full cost
Selection decision	Usually the head or the l e a	Staff with without Head's direct involvement.
Character of change process	Research. Develop. and Diffusion (RDD)	Problem Solving (PS) or Symbolic Interaction (SI)*
Expertise necessary	Operability and Application skills	Evaluative and application skills

Throughout the literature of innovation, resistance, be it organizational or personal within the institution of the school, has often come about due to the lack of participation by those who would be most involved in the operating of the change proposal. The Department of Industry offer of hardware ensured that micros would be in schools and this was supported by the moral/educational encouragements for exposing young children to them. However, lack of consultation at any level can engender resentment among teaching staff members who may be experiencing personal misgivings towards the micro in school. Teachers may not have been ready in many ways for the micro's arrival. Their resentment at an imposed technology could easily fuel pedagogical rejection with individuals saying: "I've managed so far without it," or "I can't see it helping me," and therefore refusing to try its potential. Doyle and Ponder's Pragmatic Sceptic may have good reason for being so, but equally, scepticism may occur simply because the preconditions for successful implementation were not in place at the right time. If there is one major criticism of the RDD change process, it is that those involved in developing and disseminating educational innovation often inadequately take into account the needs (and preparedness) of schools.

So, the machine has arrived, plugged in, bleeping and ready to go. Surely it is better, some might say, that schools *have* micros rather than not and at half price. Certainly the case for its educational potential has been made convincingly and too often to be repeated here. What does need stating is the fact that – unlike the business world, where hardware may be the life-blood of efficient commercial activity – education is a profession resistant to new instructional aids in the classroom. Personal fears may be groundless, but the disparity between the way hardware and the way software has found its way into the primary school will leave those unconvinced staff members itchy and resentful that they were not consulted in the first place.

* For further exposition of these change processes see Havelock 1970.

Perhaps though, (from the point of view of the British computer industry and from that of our childrens' future) it was as well that thorough consultation did not take place! An informal poll taken by a head teacher colleague among 26 heads in a London Borough addressed the question 'What weight would you give to the computer compared with other resources?' 80% gave priority to other resources. On being asked if they would have spent the money on other resources if the Department of Industry's offer had been a general DES offer of cash for curriculum development, a similar majority said that the money would have been spent on existing resource development. This adds even more fuel to criticism of the Top-Down (RDD) process of disseminating change. Change without (or with little) choice is not, in the literature of educational innovation, the best way to secure successful adoption even with an innovation as heralded and potentially crucial as CAL in the primary sector. It must be hoped that in-service training and education, teacher-centre support systems and staff creativity will overcome the possible gulf that may be opened up by Stone-Age Obstructionists and Pragmatic Sceptics at *all* levels of the system, who may assert that the micro was far from being an answer to anyone's prayers – least of all theirs!

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Time for Change? Can We Change? Information Technology in the curriculum by Tony Gray

Tony Gray is Director of the Primary Micro Project, University of Technology, Loughborough. His team has produced a number of innovative pieces of software and here he discusses some of his thoughts following a recent review of current school usage of the micro.

The government has spent millions putting micro-computers into schools. There have been introductory courses, hardware schemes, national curriculum development projects, an Information Technology (IT) year, the establishment of fourteen regional information centres and an involvement by publishers and others in the provision of software. So what has happened? Has the curriculum undergone a major upheaval? How are teachers coping with this new equipment?

In order to answer these questions I have been visiting schools all over the country and talking to teachers. As might be expected a range of responses was found, but a pattern of usage seems to be emerging which indicates that teachers are not yet realising the potential of the micro as a resource.

Of course slow take-up of new ideas is not a recent phenomenon. Look at any curriculum innovation of the past twenty years and you will probably find the same. Recent reports even suggest that many primary schools and teachers are still orientated as they were before Plowden. (1) Teachers are rightly wary of 'experimenting' on their classes. They are used to ideas coming and going, and with computers they wait to be convinced. However, in this case, such professional and institutional inertia may become a real threat to essential curriculum development, and in this article I would like to share with you my feelings about present practice and future changes.

Present Practice

Here's a tongue in cheek description of a 'typical' school and its new micro. As I look round, no single school has all these features, but it's possible that some of them will seem familiar to you.

Imagine a school. One day several large brown boxes arrive: the micro! Perhaps someone sets about the packaging with enthusiasm. The others wish they'd never seen the damn thing, particularly those who've been forced to go on the initial training scheme because no-one else would. There is a tremendous temptation to hide the machine away, but the children know its arrived and so do their parents. The children want to play games or program. The parents want the children to have an edge in the new technological future when competition for jobs is high. Furthermore the LEA seems to think that it's important. There's no escape.

If they're lucky, the staff will have an Enthusiast who'll look after the micro, thereby exonerating the others from having to bother. The Enthusiast's motives may range from boredom, through genuine interest, to being an active member of the escape committee, having been in the school now for more than 7 years: the micro takes on the role of wooden horse.

The next thing to happen is that everyone feels they have to use the machine, especially as the head has instituted a timetable. (A half- or whole day a week per class is the typical pattern.) This seems a natural approach because the computer looks like the TV or video, and consequently may be used in the same way. Deciding to organise usage in this way has an important impact on the teacher's effectiveness in using the school's computer.

Why?

If a class has the micro in short regular bursts, it pre-determines the sort of software that will be successful and how the children will be organised to use it. For example, the teacher will do a calculation along the lines that each child should use the micro, there are 30 children and, say, four hours available. The class will therefore be arranged into small groups which are then rotated to ensure that each gets its twenty-minute 'dose' of computing each week.

Most of the free software available to schools is suited to this 'short doses' mode of working and so is successful in a limited way. In a separate article I have identified software of this kind as having Fixed Focus. (2) Fixed focus material is fine but it explores only one limited use of the micro. It will usually be orientated to specific pre-determined objectives and will cover existing, easily identified, areas of the curriculum. The teacher will not need to make special preparations, the programs are self-contained and the teacher knows what will happen and what the outcome will be. Further, these programs often address the traditional "basic skills" and so satisfy the parents: the old curriculum in a new suit of clothes.

So here we are. The head has his time-table and feels the micro is being used; the parents see the machine in use to achieve 'basic' goals, skills and knowledge they recognise and feel happy with; and the staff don't have to make a special effort to learn anything or change their approach. Everyone's happy: a nice closed system which ensures that the new is absorbed without changing anything.

Travel around the country confirms that something like this is happening in many schools. The micro is being used, but only in a way which is strictly limited. The children and teachers do pretty much the same as they always did.

If, because of your experience, you're tempted to disagree, remember that the very fact you are reading this journal makes you a special case. Research has shown that most teachers don't read journals, except the TES jobs pages.

This situation is worrying: not only because of the narrow usage of IT indicated; but also because it seems to suggest that with the exception of a fairly small number of schools, the profession is failing to see the necessity to reconsider its role and the needs of the children in the light of our changing society. I believe that such a review is overdue and I would now like to look briefly at why this should be.

The Need for Innovation

Life in the 21st century will not be as it is now. The recent MEP/NEC booklet 'All Change' (3) draws together evidence for movements in society which ought to be concerning all those engaged in the education of our future citizens. We should not continue to prepare children for a world which we know does not any longer exist: a world of full employment and limited leisure time, free from robots and information technology; the world which we were all educated to live in.

Changing the curriculum so that our children are prepared for their life in the 21st century is an urgent priority, and the DTI/DES initiatives are a recognition of this fact. This is not just another bandwagon; this is education for survival.

We are in a unique environment with this technology and its impact on schools. IT will literally change the world and we have to adjust our teaching to take account of this. Very powerful pressures are operating: agencies of government, parents, children and industry; any one of which can influence strongly what, why and how teachers do their job.

If you doubt this, look at the network of MEP Regional and National Information Centres for mainstream and special education. Look at the staff of these centres, some of whom have titles reflecting areas of major importance such as In-service Training and Curriculum Development. Look at the range of support they offer schools, and then look for similar government sponsored agencies offering the same scale of help to schools wishing to develop their curriculum in such areas as Maths and Reading. There has never been anything quite like it.

If you still doubt, consider the number of computers purchased by parents for their children at Christmas; machines which have been heavily promoted as having "educational" value, which they believe will give their children a 'start' and which often cost in excess of £400 for a system. Hard earned money invested by parents in their children's future.

So this is a special case; the problem is that up to now much of the attention by all groups has been on the hardware, rather than concentrating on the curriculum issues. Consequently, under-trained, unconvinced teachers are happy with the status quo described above. They know no better, and at least the children are becoming familiar with the machines.

And it is very hard to get away from the machines – the actual kit you see and feel – and concentrate on their uses. After all, they confront the teachers in the classroom and there is a feeling that they have to be mastered. Further, machines cost money which has to be raised by PTA effort and people like to see what they're getting. Raising cash for teacher training for example would be very much more difficult.

It is here that the challenge to the profession lies. We must begin to develop our professional skills by devising efficient in-service training. The government has given us the equipment, it is for us to adopt and adapt, think and re-think our teaching before someone central in the DES or the MSC does it for us. (The civil servants in the MSC are spending millions on schemes which involve the education and training of young people.)

Curriculum and Staff Development is where the need for innovation lies. And we can begin by looking at what we are doing at present and thinking how this might be improved.

What Can We Do?

Any attempt at a prescription for all teachers is more or less doomed to failure; thank goodness the profession still maintains a healthy independence. However, perhaps you'd like to consider the following as you debate the need for change in your school:

1. Timetabling – organising usage.

Our work at Loughborough has clearly demonstrated that the best use of certain types of software is when the micro is allocated to a class for a block of time, say two or three weeks. Deep and creative thinking, particularly arising from a collaborative effort, needs time to grow. Certainly, our OTHER WORLDS, MICRO MAP and KINGDOM OF HELIOR packages work best when the children are given the time and freedom to develop ideas as they think about their work. (4)

In an environment where a school has six classes and only one or two micros this may seem unrealistic, but in our view the benefits outweigh the disadvantages.

> the children and teachers can plan to use the machine in the usual way, and also use it when something unexpected crops up;
>
> major projects and topics can be engaged in, the micro playing its role alongside other resources, constantly available;
>
> the program packages themselves can be more elaborate, having a variety of associated materials and demanding that the children actually think rather than merely respond (as is often the case with Fixed Focus material);

and

> the machine can take on a variety of roles during this extended period, running the Fixed Focus material as well as the more open-ended, content-free program.

Re-arranging the timetable so that teachers have the machine for longer periods of time raises other issues. For example, is it better to give the machine only to those teachers willing and able to benefit?

In my view, the answer here is to fix one day a week in which the micro does its round of the classes in the usual way, the remaining four days being allocated to those who will use it to the full, ie. one class has the machine for three weeks, four days a week. If this is done, all children get to use the machine (thereby avoiding arguments); and if the 'long term' teachers really begin to use interesting and adventurous software to advantage, word will get round and others will clamour to use it. (That's when the trouble really starts!)

Of course this is just one pattern. What I'm asking is that we beware of simply putting the computer round the school. Teachers' attitudes towards the micro will surely be affected by the time-table. If it's offered as something to be used briefly, in a restricted way and without preparation, the children's work and the teachers' attitudes will reflect this. Think about how logistics affect the type of software you can use and the type of teaching and learning encouraged by that software; and then adjust your time-table accordingly. If you've more than one machine, perhaps you could keep one in a central role whilst moving the others about.

2. Labelling – looking at software.

People like to label things so that they can be categorised. It makes life easier. You can look at a program or a book and say "That's a maths book." "That program's for geography." This is fine if you are using only simple software. The area of focus will usually be fixed, and the program will indeed be for 'Maths' or 'English' or 'Spelling'.

However, one of the strengths of the micro is that it can be used as a very flexible aid. A word processing chip might be used to write up experiments (Science), poems (English), stories (French), letters (Administration) or even articles for educational journals. A data base might be employed to juggle historical facts, census returns, tree surveys or information about the children's pets.

How would you label these programs? Certainly not by subject.

However, these programs do not suffer from teachers' desire to label resources. This is because these applications of the micro are found outside education and will therefore be in the teachers' general awareness of the technology and its uses.

The real victims of labelling are those solely educational programs which can be used over and over again in different ways, for different subjects or topics. Such software cannot be quickly described or demonstrated and relies on the teachers' ability to recognise applications. Flexibility means that these programs do not lend themselves to being labelled for a single subject, and are therefore missed by many teachers who would find them very useful. (5)

Software of this kind emphasises the teacher's professional skills: her ability to help the children manage their own lerning; to select resources; to encourage, discuss and guide the children. It relies on her ability to create a rich environment which will help the children acquire those fundamental skills (of language, number, thinking, information handling and getting on with others) which will be valuable to them in the future. In other words this type of software can help children engage in the process and experience of learning rather than simple, mechanical, pre-determined exercises.

Examples of this type of software can be found in our OTHER WORLDS packages which have been used successfully right across the curriculum. To label them 'English' would be to miss the potential for number or science work. However, they can be used to promote creative writing or to study a book or poem. The HELIOR package might be argued to be a 'Maths' adventure game, but it could equally be used as a basis for art work or drama.

The argument here is that when looking for software, teachers should be aware that this is a new medium of flexibility and power. And this will increasingly be the case as research and development work shows new ways of using the micro. To look for programs labelled in the traditional way might be to miss really valuable resources which can be heavily used throughout the school.

The advice is plain: recognise that software exists which has a broad application and which can be easily used across the entire curriculum. Don't use restricting labels.

3. Micros and learning – the role of the teacher.

Computers, word-processors, data-handling equipment and so on will mean that people's time in the future will often be self-directed. This may be for work or leisure purposes and we need to prepare people to cope with the responsibility of this kind of life. (If you think that education for leisure is a joke, look at the large number of bored, un-employed young people hanging about shopping precincts trying to pass the days.)

A discussion of the curriculum to do this is outside the scope of this article, see 'All Change' for one view. (6) It is plain however, that to prepare young people for a rapidly changing society with ample leisure and new types of job being created, we will need to move away from a curriculum dominated by factual knowledge to one which concentrates on the acquisition, development and application of skills. This is because skills are transportable, whilst facts can become outdated. For example, being able to find out and validate information is much more widely applicable than knowing that the Battle of Hastings was in 1066. Knowing how to learn, and liking the learning process, is a central life skill even now. It will become even more important in the future.

To do this will mean looking closely at roles in school. If young people need to become self-motivated, self-disciplined and self-directed we must devise ways of helping them do this. It is no good complaining that they can't think for themselves when they know they'll be told everything by the teacher if they wait long enough. The teacher, however, cannot abdicate responsibility for the children's learning. Classrooms need to be rich environments within which children learn, the teacher's role being to provide this environment by way of books, artefacts, visual materials, activities, equipment and software. Organisation, preparation and classroom management are essential skills in a good teacher and this emphasis will remain and increase as new resources based on IT come along. (7)

None of this, fortunately, is new. The messages of Plowden and Bullock become ever more relevant:

> Teachers cannot escape from the knowledge that children will catch values and attitudes far more from what teachers do than what they say. Unless they are courteous, they cannot expect courtesy from the children: when teachers are eager to learn and turn readily to observations and books, their pupils are likely to do the same. There is little hope that the children will come to an appreciation of order and beauty in nature or what is man-made, unless these qualities are enjoyed by their teachers and exemplified in schools. (8)

The teacher is still the key feature of a learning environment, whether or not it contains new technology.

So where does the micro fit into all this?

Remembering my description of the current state-of-play in schools, you will recall a heavy emphasis on machine-directed drill and practice; the opposite of the approach I've just argued we need; the antithesis of open-ended, research oriented, self-directed learning by doing.

The message is clear: the micro can be a flexible resource, enriching the classroom. It can be used to practice skills when appropriate. However, a micro should more often be used to give children the pleasure of controlling and handling facts and processes: true self-direction in learning. And since so much of the better software now being produced encourages discussion and collaboration, the teacher can work along with the children as guide and not only 'The-one-who-knows'. Adopting this approach will ensure that the children's time at the micro will be genuinely helpful to them in the future. It is not a new approach, it is integrating the micro with existing good practice.

Conclusion

In this article I've tried to outline some current common practice in schools, discuss the need to change this practice and give some specific points to consider in order that this change take place.

Little here is new, even the ideas concerning use of the micro are fairly established if not thoroughly researched. However, institutional inertia is such that despite the existence of well understood and agreed arguments in favour of using process and experience as a route to learning, many schools still do not adopt these methods (9). And instead of being an agent for change I see the micro being used to entrench the very worst of out-dated and poor methodology.

This situation is not simply a result of introducing IT in schools, and classroom teachers are not wholly to blame for being resistant to change. Some will never change, but many wait to be convinced of the need to alter their approach. This is where the need for pressure on the DES comes in. Training is the key. Not the pinch-penny 'This is a micro and this is how it turns on' style. We need a properly conceived programme of curriculum development courses for teachers, heads and advisers outlining the case for urgent change. Change not only in how teachers can use information technology, but change also in their conception of the role of their schools.

Now this is heady stuff and I realise that the pragmatists will already be shaking their heads, particularly in the light of recent pronouncements by the Minister. However, it is possible if the need for staff development is impressed upon those who pay for the education service. After all, three years ago the number of micros in primary schools was tiny. It can happen. The profession must begin to lobby for the resources to prepare our staff for the future. If we do not, we shall find schools continuing present undesirable and unsuitable practice, and the impetus of the last three years will be dissipated into a backward-looking irrelevant curriculum.

For the sake of the children this must not happen.

(1) see "Basics still top of the junior timetable" – reporting work by the
NFER contradicting the popular image of the post-Plowden junior classroom;
The Times Educational Supplement, 7th December 1984, page 1.

(2) Gray, A.F. "Versatile Focus – a way of evaluating software", The Times Educational Supplement, 9th November 1984, page 51.

(3) Dutton, P., Nicholls, P., and Prestt, B., "All Change", MEP, 1984

(4) Software like this falls into two other categories [also described in reference (1)]: Pre-focussed and Variable Focus software.

(5) OTHER WORLDS – The Explorer, OTHER WORLDS – The Inhabitant, MICRO MAP 1 and 2, THE KINGDOM OF HELIOR and all the Loughborough Primary Micro Project software is published by Longman. Contact David Jamieson on 0279-26721 for a free video showing the programs being used in school.

(6) see reference (3)

(7) Such devices as talking computers, interactive video systems and pocket word-processors already exist.

(8) Plowden Report, "Children and their Primary Schools", volume 1, paragraph 876, page 312.

(9) see the NFER report mentioned in reference (1)

The Good, the Empty and the Interactive programs for primary education by Alistair Ross

Fox Primary School, Inner London Education Authority

The injection of a large number of microcomputers into primary schools by the Department of Trade and Industry has been seen by many as heralding a giant step backwards for primary education. Teachers who had for years concentrated on helping children establish meaning in mathematical understanding, given the micro, revert to drilling children in basic computational skills. So-called "reading" programs demanded children bark at the screen rather than bark at traditional print. "Language development" programs ask children to provide a word that means "to do with teeth" and tell them that "Dentist" is incorrect – they should have typed "Dental"! Inspectors report seeing good progressive primary education in a school – until they come to the use of the micro, where teachers are doing things in the name of education that they wouldn't normally dream of. Why?

"The children are happy," say some, in the belief that happy children are good learners. Unfortunately, while good learning takes place when children are happy, it is not necessarily true that because a child is happy, he or she is learning! Much educational software is no more than the electronic equivalent of the dancing girls my old French master used to threaten to bring into the classroom in order to keep our flagging attention on our work.

Nevertheless, I use the micro quite a lot with the teaching that I do with my junior classes. The micro is frequently in use all day in the classroom, and I believe that the quality of the educational experience that the children are getting is considerably enhanced. How can I reconcile this belief with my earlier remarks? The answer is simple: it lies in the nature of the software being used.

Three kinds of educational software

The argument I want to develop in this paper is that there are three kinds of educational software that are available to schools. They are not simply three gradations along a scale: these categories provide completely different possibilities for learning. The nature of what is possible with any program depends on the group into which it falls.

Firstly, there are the great mass of "skills and drills" programs. They are easy to write – any learner programmer can come up with an arithmetic tester at the end of lesson one. They blossomed in the first micro wave, four years ago: they have since developed in sophistication and graphical displays, but the object is the same. Teach 'em their tables, make 'em spell with Spelling Simon, . . .

play with logi-blocks, put apples into order . . . hang on! Why aren't children using real logi blocks? Real apples – or at least, pictures of apples on real bits of cardboard that they can juggle about? I know it's easier to switch off the micro at 3.30 than to go round tidying up the apparatus in the classroom, but surely manipulating things in the real world is better than manipulating things on a monitor screen? The first category of programs is, therefore, the one labelled "rubbish".

The second category is quite different. This is where most other educational programs can be found. These are imaginative ways of helping children acquire a specific skill, understand a particular problem, evaluate a certain situation, predict what will happen in a particular set of circumstances. The key factor that distinguishes this group is that they are specific. There may possibly be some changing of variables by the teacher, or by the child, or some random element within the program – but, by and large, the program is written to help children in one particular way. A skill or a concept – or even a small group of skills and concepts – have been isolated and are approached through the program.

The common element in these programs is that they are conceived of as peripheral devices to the existing curriculum. They take what already goes on in good primary education, isolate a specific aspect of it that can be taught with the assistance of the micro, and provide a good, work-a-day product that meets that percieved need. There is nothing, I hasten to say, wrong with this approach: the familiarity of the content and approach mean that many teachers first come to use the micro in the classroom through such programs. But they are hardly revolutionising education. They are rather similar to filmstrips thirty years ago – an excellent innovation, a way of making the curriculum more lively that was undreamed of a generation before, but not really innovative.

When teachers are well used to these programs, they will begin to question the use of the micro. Although they might not have cost the school a great deal, because of subsidies, are they really worth it? Is the future just going to be a succession of more film strips/programs?

There is, however, a third, tiny group of programs. These will challenge the existing curriculum, and will eventually change it. This group is the group of my title: the good, the empty, and the interactive. Heather Govier has called these "Toolbox Programs", by which she means a limited set of multi-purpose programs that can be used, by children and teachers, to construct knowledge and develop skills in an interactive way – interacting with each other, as much as with the micro ("The Toolbox: Microcomputers in Primary Education – the way ahead", Heather Govier and Alistair Ross, Ward Lock, 1985). The attributes of this group of programs are that they

★ develop communication skills
★ develop information handling or problem-solving skills
★ facilitate changes in attitude
★ are "content-free", or empty
★ enable children to interact
★ enable children to speculate freely.

What is an "empty" program?

What on earth, you might ask, is an "empty" program? Simply one that can only perform a task when supplied with information, content or commands that the user gives it. Three straightforward demonstrations of this are

★ LOGO – there's nothing but a screen turtle sitting there until commands are given to move it;
★ A word processor – the screen is blank until text is entered to be manipulated; and
★ An information retrieval program – nothing can be retrieved until a collection of information has been compiled.

In each case, children and teachers have to tell the micro something before anything can happen, and they have to evaluate and discuss what does happen in terms of what they put in, rather than simply of what the micro did to it. What is put in – the content – is what the child wants, and is based very largely on their perceptions of the world – constrained, it is true, by the nature of the program and its limitations, but constrained far more lightly than is the case with the vast majority of programs.

The use of these programs demands a high level of inter-activity – in particular, of conversation and speculation between children, often away from the micro. Children collecting data, and pouring over the meanings in printout of their enquiries; children debating pieces of texts; children speculating on the sequence of commands necessary to move a robot arm in a particular sequence. The skills in such conversation are not just important social skills (of proposing, evaluating, defending, arguing), but skills of interaction developed in a context.

This context is that the micro allows ideas to be very easily tested out – quickly, efficiently, accurately. Would the story read better if this incident came first? Try it and see. Could this pattern be developed more quickly using that LOGO definition? Try and see? Is this factor related to that condition in our experiments? Make a data search and see.

The ability to speculate now becomes more focussed. If children see their ideas as being essentially untestable – because there are so many ideas, because of the problems of repeating boring repetitive tasks, because of limited concentration spans, because of inevitable inexactitudes – they will not bother to speculate intelligently. Give them a program that allows the speculative to be checked, and they will not only come up with ideas – they will be able to check them out painlessly and discard those that don't work out. The dominant phrase becomes "What if . . .?"

The micro thus is a facilitator in the classroom: it gives children space to construct and discuss theories. In a classroom dominated by the learning of simple routines, there is often not enough space to talk. This kind of micro activity creates space, and encourages fruitful debate. Because it is now possible to try ideas out, in a range of modes, to see what seems to work best, it becomes worthwhile thinking about what is best. There is time to create criteria, not just to accept them.

There are not many programs in this category. Word processors, a relational data base program and LOGO have already been mentioned. Add to this a hierarchical data base program (like ANIMAL), a TRAY type program, a control technology program, a quiz maker, a view-data system, and adventure game writer, a spreadsheet – and perhaps that is about it.

The categorisation of "toolbox" programs

I would like to suggest that a categorisation of such programs might be useful. There are three different kinds of program in the toolbox, each of which performs a very useful function.

INFORMATION HANDLING
Problems of handling information

These programs do not just allow children to rapidly access information, but to control the input of data and its manipulation; and, more importantly, to decide what information is relevant and how it should be interpreted.

TEXT HANDLING
Problems of communicating

These programs allow children to understand both the logic of a language, and to discover the rules of its use; to experiment with different forms and formats; to discuss levels of meaning.

CONTROL PROGRAMMING
Solving problems in logic

These programs allow children to operate in a logical world, manipulating objects on the screen or in life, creating techniques to sequence instructions in a logical and satisfying manner.

In each category there is (or will be) one program that is pre-eminient: one that is flexible, exciting and enabling. One of these important programs (in the third category) doesn't exist yet, at least in a primary school-usable version.

These three are:

INFORMATION HANDLING
A relational data-base, that allows children to construct information files of information that they have themselves collected; to search through this to find relationships; to display what they have found in a variety of graphical ways; and encourages them to speculate on the meaning of what they have discovered.

TEXT HANDLING
A word processing program that lets children enter their own text or – story, poem, description or whatever – and then manipulate it so that it accurately reflects what they want to say, and check through it for grammar, spelling and sense, and produce fair copies in a "publishable" form.

CONTROL PROGRAMMING
A program that allows children to control a number of devices and to collect readings from peripheral devices, constructing a program to move mechanical, electrical and other devices, if necessary in a conditional way upon the sensory input devices.

There are other programs in each category: again, I would suggest a hierarchy, with the next level of programs being represented by these three:

INFORMATION HANDLING
A hierarchical data base system – one that allows children to explore similarities and differences within a category. ANIMAL is a popular example of this genre, though ideally it should not be limited to animals, nor is there any reason why this type of program should be so fixed to binary trees – some questions have three or more answers.

TEXT HANDLING
Programs of the TRAY type are more than sophisticated guessing games ("the best thing since Scrabble", says an advertisement for one commercial version): they enable children to explore the structure of a text in a way that helps them better understand all text; and in a way that lets them discover the rules of their own language.

CONTROL PROGRAMMING
Logo allows the control of either a real turtle, moving in two dimensions, or of a "screen" turtle, again in two dimensions. True LOGO allows considerably more sophisticated programming (one can, indeed construct other empty, toolbox programs) but simple list processing is the most usually attempted in primary schools with full LOGO.

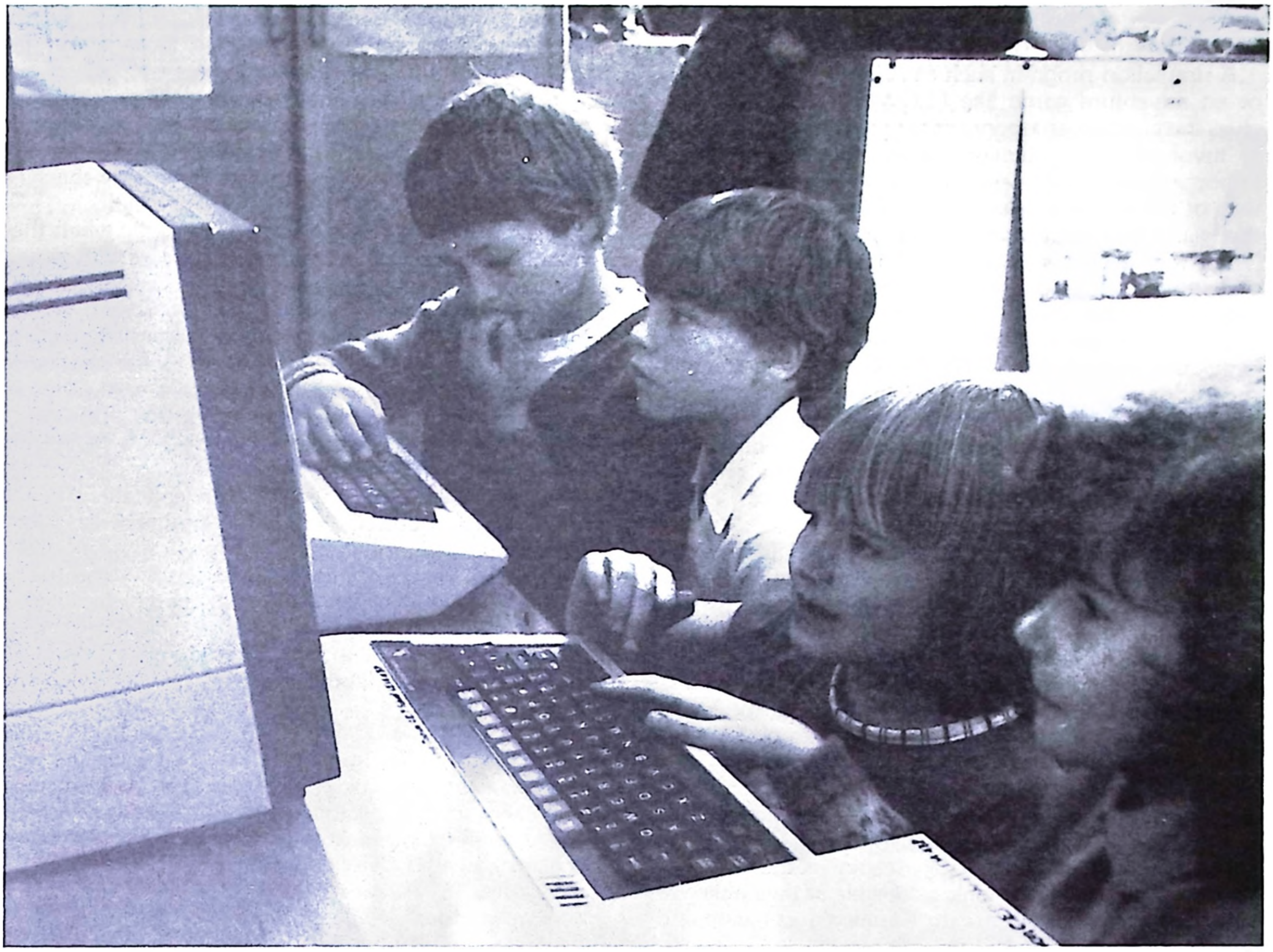
Many may dispute the lack of primacy given to LOGO in the above schema: it could be argued that any control technology program should be merely regarded as a sub-set of LOGO. I would suggest the reverse: LOGO, whether turtle-graphics LOGO or "true" LOGO, is an interesting two-dimensional aspect of a full control technology program. This I would see as a set of peripheral devices – motors, lights, valves, touch sensors, light sensors and the like, all of which could be controlled by a programming language. They might be embedded in units of some constructional toy such as Lego. All could be connected to the input/output port of the micro, and all could be "seen" on the monitor in a variety of ways – as a drawing, as a circuit diagram, and so on.

Other "toolbox" programs seem, at present, to fit in reasonably well as lesser examples of these three categories.

One common element in all these programs is that they aren't easy to get started with. There's no question of switching on and pressing ESC/SHIFT or B, and away it goes – one has to sit down for an hour or two with a manual (not usually very well written) first, and the first results are often frustratingly slow. But persistence brings competence, and competence with a program that will be very long lasting and flexible.

More fundamentally, the use of these empty programs will begin to change the school curriculum. Our attitudes to information will change: it won't be (as is sometimes simplisticly suggested) just a question of teaching children where and how to find information, but of judging the significance, meaning and value of the information retrieved. Our attitudes to writing will change, as we realise that text is increasingly less fixed, and more capable of change and permutation; we will be increasingly less concerned with the mechanics of writing, and more with clarity and meaning (just consider the implications of a portable voice-driven word processor!). Finally, conceptions of logic and sequence will become more finely honed through the use of structured and purposive programming languages that enable us to control objects in the environment.

The new curriculum that will emerge will be more child-centred than the present model. It will enable children to understand and take charge of their world, to become autonomous learners. A far cry from Punctuation Pete!



Children, Teachers and Computers by Alan McKechan

Hillbourne Middle School, Dorset

I know of no other teaching-aid that has had so much written about it. Just trying to read it all is a full time job. However, because the computer can be used to support many different approaches to education I see a need to contribute to the discussion with yet more words. In America, for example, the microcomputer seems to have revived an interest in programmed learning. In order that we can be clear about our intentions for using micros in schools, and that others might understand and support us, we perhaps should begin by considering our aims.

Education with computers may contribute to several general educational aims; in particular, any aim which refers to helping children to prepare for adult life in a fast changing world. Some children in Primary Schools now will enter that adult world in the 1990s and although predicting ten or even five years ahead is difficult, we know that computers and information technology will play an ever increasing part in shaping that change.

The computer may also help towards any aims that are to do with 'learning how to learn'. Computer based information systems such as Prestel are with us already and will hold much of the data of today and tomorrow. A person will need to know how to gain access to these resources as well as the more traditional ones, but the study skills required also involve acquiring the mental structures to frame appropriate questions and to make knowledge and information out of raw data. This is important, not just for social utility, but for the autonomy of the individual. A person's ability to make and understand decisions will depend on information to think with. Along with this goes his or her ability to make an assessment of the validity of the information and to participate fully in a democratic society.

One objective that I would propose for computer use in my school is that it should help both teachers and children to use the new technology for purposes that are real and significant to them now, not just for some hope that by using it in their class they are giving keyboard familiarity and preparing for the future. There are many examples of the increasing use of computers in an adult context but at present about the only situation of real concern to children is game playing. Perhaps this is why they persist in calling programs games rather than simulations, programming languages or databases.

My own purpose in encouraging this technology is that with certain software I see it promoting a classroom environment that involves group work, thinking, whole-curriculum planning and an emphasis on the process of learning. These things can and do happen without microcomputers, but some software facilitates and thereby reaffirms the value of this approach.

A simulation program such as ADVENTURE ISLAND or an adventure game like FLOWERS OF CRYSTAL gives the children an opportunity to become imaginatively involved in a situation where the outcomes are important to them. Because there is often more than one way of arriving at a solution they solve the problems of the 'game' by making and testing hypotheses.

For the teacher such software offers a stimulus to a wide range of language and other work as children record, over the weeks, their exploration of a complex but bounded micro-world. A historical, archaeological simulation such as the MARY ROSE enables a study of the Tudor period to be based on an evidence approach. One group of children used a copy of an engraving of the English encampment at Portsmouth to help decide on where to start searching for the wreck. With a program like ARCHAEOLOGY teachers or children can create their own site database to be explored.

An information retrieval program like QUEST seems further removed from children's needs and interests, but they can discover that the speed at which it searches and sorts information enables them to find answers to their own questions quickly and that one question asked leads to another. We have found, for example, that a database of Victorian Census information for a local study area allows children to make and test hypotheses, using the computer as a tool to conjecture about the past.

For the teacher there is again the chance to use an evidence approach, to develop work with charts and graphs, and, above all, the interpretation of information. If the children have entered at least some of the data then they may realise that it is only as reliable as their ability to decipher copies of faded 19th Century documents and their accuracy on a keyboard.

We now move to a context that was chosen to be interesting to the child and that is LOGO. Of the three uses of the computer that Papert found were the most fascinating for children, we have only some experience of using screen graphics with DART. The other areas were music, sound effects and robotics through use of a floor turtle. Most children who have wanted to learn to program their home computers have wanted to produce graphics such as they see in commercial games. Given a LOGO with 'sprites' (several screen turtles which can be given different shapes and movements) then children could really use the machine for their own purposes. On offer for the teacher is the chance to create an environment where spatial concepts and mathematical ideas are used by the children for a real purpose. If a robotic turtle is available then the computer is used as a controlling device.

With a turtle, pupils are using a programming language, but is it a 'real' language like BASIC? Even today, some computer science lecturers are facing problems with students who have extensively used present home computer languages. A trend in programming appears to be towards higher level languages that are closer to natural language or thought. LOGO, because the words are given meaningful names by the programmer and because it encourages an approach to a problem that breaks it down into smaller problems, is closer to both of these than BASIC.

DART is a simulation of some aspects of LOGO, written in BASIC, and it does not have any of the commands that process words, that would be found in a full version of LOGO. I am not sure whether full LOGO could allow children to explore language in any comparable way to their investigations of graphical micro-worlds, but Papert does have very positive ideas about the impact of word-processing on writing.

We have not yet been able to give word-processing to children and teachers because we do not have enough keyboards and screens for any in-depth work to take place. The advent of a cheap, small, portable machine with built in word-processing could change that.

Whilst machines are scarce, and hopefully when they are not, we can do interesting language work with groups of children using a program such as DEVELOPING TRAY. The text is 'developed' on the screen by the children using all their knowledge of written language to make predictions. For the child there is the chance to solve problems with a group, to argue a case, listen to others and then to proceed by concensus. The group purpose focusses on solving the 'puzzle'. For the teacher there is something that can enrich pupils' feeling for the structure of language. The teacher can 'create' any text to be 'developed' and therefore the program has great flexibility.

At present we do not have access to other computers through the telephone network, and, apart from showing that such links are possible, there is little available at present that is useful to primary children or teachers. There are, however, some interesting developments in the adult domain.

One of these is TACIN – Town and Country Information Network – which provides a low cost electronic mail information service for community groups. This makes it possible for small groups of people to command information resources that enable them to deal with complex problems such as defending a local rail service that is under threat.

A similar index detailing information and experiences relevant to children, schools and their communities would enable them to use information technology for authentic purposes: to plan trips; to set up a Youth Club; to put the case for a crossing patrol or even to defend a school threatened with closure. At a time when the trend is towards more centralized power, such an information resource would really enable children and teachers to take an active part in local decision-making.

To achieve the above purposes with the limited resources at our disposal a lot depends on how we organize the use of our micros. Newman College Primary Computing Project reported that schools often organize their computer time on a rota with each class having the computer for, say, a half day a week. This system ensures equal access to the technology but makes continuity and integration with the curriculum more difficult. In my school, we have adopted a 'cafeteria' approach where classes and year groups book the computer time as they need it. Working in half-term blocks they can plan to use the computer as far ahead as they wish. Despite practical difficulties such as stairs we ensure, with children's help, that the micro goes to the classroom. (The system is used and carried in a shallow wooden tray, only the monitor being taken separately in a two handled plastic crate.) This has allowed us to use the type of software described above which supports or even generates the context for much of the curriculum.

The disadvantage of this organisation is that in the short-term classes do not get equal access, because some teachers take to it more readily than others. However, as software becomes a more vital part of curriculum planning I am hopeful that by developing the work outlined above we can give both children and teachers the power to use the microcomputer purposefully.

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Programs
Adventure Island. Ginn
Archaeology. Cambridge Software House
Dart. AUCBE
Flowers of Crystal. 4Mation Educational Resources
Mary Rose. Ginn
Quest. AUCBE
Tray. MEP

Using a Micro with all Age Groups by Rod Williams

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This term has certainly been different for me. (How often have we heard that one before!) The distribution of numbers of children in our school have been such that this year I do not have a class of my own. The Headmistress thought it would be a valuable opportunity to use me as a 'floater' giving as many children as possible experience on our two computers, a B.B.C. Micro and a Texas Instruments T.I. 99. This sounded an excellent idea to me and I began in September full of enthusiasm with a micro under each arm. It had been my plan to take each class in the school (with the exception of the nursery), for half a day each thus relieving members of staff to attend to lesson preparation, mounting work and/or withdrawal groups. As with all things the best laid plans etc. something felt wrong with this original idea.

The crunch question
Quite often on courses teachers ask me what I consider is the crunch question i.e. organisation and the micro. So here it was staring me in the face. I had started out with wild enthusiasms and had not thought it out properly. A staff meeting was duly held and a properly structured time-table was thrashed out. I would still take the class for half a day but not the whole class together. It was decided that half a class would be a reasonable number. This

would ensure a fair share of actual hands on experience for each child although even this is not ideal and the whole thing may have to be re-thought over the Christmas holidays. However the result was half of half a class for half of half a day. Sounds confusing but isn't really. (At least that is what the children tell me since they all seem to know when it is the turn of their particular group.)

Having decided upon a time-table the next problem was software. First and foremost what software did I actually have and secondly could I persuade the head to purchase certain items if I felt they were necessary additions to our software library? Fortunately the head made some money available to me and at the beginning of term I had a reasonable amount of software to use. The software I had seemed to fall into one of four categories. 1. Drill and practice. 2. Information handling. 3. Problem solving programs. 4. Logo.

Using Dart

I decided firstly to attack some aspects of Logo since the computer department of the Manchester Teachers' Centre offered me the use of a Jessop Turtle. The Turtle is driven by the program 'Dart'. Using a floor turtle as opposed to a screen turtle proved to be of enormous value to the children to introduce them to the idea of a graphic facility that could be commanded. With both the infant and junior classes I introduced the turtle in exactly the same way, although of course I adjusted the language and explanation to suit. I would ask a child to stand in the centre of the group with hands forming a point in front of the waist. The members of the group would then direct the child to various parts of the room. Commands given to the human turtle had to be refined into computer turtle language but it was surprising how quickly the children got into this habit. The only confusion that arose was among the younger children as to what was a left and right turn. I overcame this problem by sticking a card with 'L' on the left side of the human and computer turtle and an 'R' on the right. The need for units soon arose and the units used for the human were paces and for the turtle they were simply turtle units. With the younger children more difficulties arose over the amount of turn that the human and computer turtles would use. A compromise was reached in that the human turtle was allowed a full turn or a half or quarter turn. The computer turtle turn was a little more engineered. I used the build part of the Dart program to allow the children to benefit from single key input. I 'built' the F key to mean Forward 50, the B key to mean Back 50 and the L and R keys to mean a turn of 30 deg. The choice of 30 deg was deliberate in that it helped with the formation of more complicated shapes later on in the course of lessons. For the very young ones I also marked the keys on the keyboard with coloured paper so that further confusion could be reduced.

For the first few lessons I allowed each class to experiment with the turtle moving it around. Soon came the point when the pen was introduced. An obstacle course was set up using skittles and the children tried to drive the turtle round the course. Later regular shapes were encouraged and the children soon discovered that three turtle turns was the correct angle for the corner of a square or rectangle. For the very young children I actually built a square so that the turtle would execute it on the pressing of the letter S. The older pupils began to experiment with triangles and pentagons and hexagons and soon wanted to develop a circle. This proved to be the most difficult task they had undertaken. Much discussion evolved with experimentation as to how far forward the turtle was going to be commanded to go and how much turn was to be input. At this stage I felt it was no longer necessary to have a rigid turn of 30 deg and so the children were free to input any number of degrees they wished. Various combinations of forward and right turn were tried from 'strange' ones like forward 2 right 90 down to more obviously acceptable ones like forward 10 right 10. I say obviously acceptable because you must remember that the children could actually see the path the turtle was tracing out. More refinements followed and the most accurate attempts (made by a group of fourth year children), was a command of forward 2 right 2 followed by another attempt of forward 1 right 1. Circles were drawn by all the junior classes and the top infant class. Earlier I stated that I was using the computer with all classes with the exception of the nursery. However, the turtle proved to be a great source of delight in the nursery and it was obvious that the children learned a great deal from it.

Adventure games

Following from Logo I ran some programs dealing with problem solving and discussion. These took the forms of 'adventure game' simulations in which the children had to make decisions according to information given by the program. The two programs I concentrated upon were 'Granny's Garden' and 'Flowers of Crystal'. I tried these programs with all the classes except reception and middle infants. Although I assume many readers will know the layout of the programs I will briefly outline them. In Granny's Garden six children have been taken away from the King and Queen and have been hidden in the garden. The job of the users is to find the children. Of course there are many decisions to be taken and many pitfalls that can be easily suffered if the wrong decision is taken. There are four parts to the program and they are all as difficult as one another although the final part is in my opinion the most difficult. The children will undoubtedly make errors and be 'sent home' by the witch, but the point of the program is to discuss what action is being taken for what reasons and if things go wrong then to learn from the mistakes and not do the same thing wrong again. The program proved immensely popular with all age groups even our hardened fourth years who I thought would think it somewhat childish. How wrong I was. The follow up work from this program has been tremendous. Stories have been written from the point of view of each different character in the program. Pictures have been painted/drawn of the main characters including the king and queen (who are not seen). Plans have been made of the garden and games have been invented albeit on a very simple level and very similar to the program, for other children to play. Drama has not yet been attempted but the story lends itself very well to this aspect of the curriculum.

Flowers of Crystal is in my opinion a harder program for children to tackle. I have been using it with third and fourth year children. The children are once again very interested in the program and the audio tape that comes with the program proves very useful. There are two parts to the program and the first part has to be negotiated successfully in order to move on to the second part. There are many more pitfalls than in 'Granny' and the group discussion of decisions is interesting and vital. The program is about the user finding six parts of the final Flowers of Crystal and helping the inhabitants of Crystal to once again live a normal life. The children thoroughly enjoy this program. The work on it is by no means finished since both classes are still trying to complete part one but already we have had pictures of 'Blids' and 'Fright Freaks' and 'Super Jim' coming out of the work. Part two of this program gives lots of opportunity to include many aspects of the junior curriculum such as maths (mapping, co-ordinates), language development, decision making, hypothesising, testing hypotheses and general group social interaction. The program when finished should prove to be a very valuable and enjoyable one for the children and their teacher namely, me.

The programs I have on information handling have been discussed in a previous article for this magazine. However suffice it to say that they are still well used by all the junior classes and they are still popular with the children, which I suppose is the 'acid' test of any software.

Criteria for using programs

Finally I would like to say a word about the drill and practice programs I have. Often when these words drill and practice are mentioned in conjunction with computers many if not all teachers shudder and raise their eyes to the roof. They are certainly not thought of as good programs. After all it would be interesting to ask all teacher computer users to write down the main criteria they employ when looking for a piece of software to use in their classrooms. My main reasons for using a certain type of software would look something like this:–

1. Does it fit with the ideas I have of the subject currently being dealt with?
2. Does the program contain material relevant to the specific point I am trying to make?
3. Does the program have the ability to enhance the work I am setting out to do in a way I could not easily achieve without the computer?
4. Is it suitable as far as content and age range for the children I am dealing with?

Those are a few of the most important criteria I would employ. There are others such as enjoyment by the children of the program. If the software I was using came in to two or more of these categories then in all probability I would use it.

However when you look at those criteria then number three on 'enhancing' what the teacher can do is probably the most important and probably NO drill and practice programs can really fall into this category. After all what is wrong with a pencil and paper or even a book and a pen. So what am I saying? Is it that I just do not like drill and practice programs or is the feeling even stronger than that? Well the answer is yes and no! I do not like drill and practice programs per se. I tend to think that pencil and paper are just as good. BUT I have seen them come into their own in certain circumstances. These are when they are used with slower learners or with reluctant learners. In my school they have proved to be a refreshingly different kind of stimulus for these pupils. They have sparked off enthusiasm where it was difficult to detect any before. They have proved to be a starting point for discussion for certain groups and they have led to the pupils gaining in confidence to try the other programs that are on offer to them in their classroom.

Well I must return to the machine now and begin updating some data files that have been built up by the lower junior classes. Once that chore is over I can return to the mysterious land of Crystal and all the fascinations and horrors it has in store for the fourth years (and me of course).

Confessions of a Teacher-Programmer by Philip Dunn

This short article may, I hope, offer some comfort to the growing number of teachers who, frustrated by the poor quality or unavailability of suitable software, are prompted to pick up the school's copy of the User Guide with the idea of writing their own programs.

I realise now that I was in no sense a pioneer as a teacher-programmer, but in 1981 when I took delivery of a Sinclair ZX81 home microcomputer, I had no idea that anyone else was using microcomputers in primary schools. Nevertheless, with great enthusiasm and high hopes I set about introducing my second-year juniors to the white heat of high technology. Or, rather, to a test based on multiplication tables, which happened to be as complex a program as I could manage at the time. However, favourable reactions from the children sustained me and helped to mask any feelings I may have had of unease, and I felt reasonably happy for a while. As the novelty of this original program wore off I became aware of a hard-to-define sense of dissatisfaction with the impact my program had made, but I resolved to improve on this effort and put this feeling aside. Further programs followed, making better use of graphics and covering various areas of the curriculum. With the purchase of a BBC micro, my programming skill increased and my programs grew steadily more sophisticated. They were less and less susceptible to problems in use and looked and sounded increasingly attractive. Alas, these too, in time, fitted into a recognisable pattern of apparent success, followed by a sense of disappointment which I found hard to pin down.

The disappointing early MEP programs

By this time I was coming into contact with teachers experiencing a similar dissatisfaction with the gap between what we wanted from the new technology and what it was actually delivering. The MEP material supplied with microcomputers purchased by schools under the DOI scheme was largely disappointing as a pointer to the direction which educational programs should take. Even so the swing away from pseudo paper and pencil exercises which had characterised so much early software (remember the tables test?) was evident in the thinking behind some of the programs.

My problem was obvious in retrospect. I found the whole business of programming the computer so difficult, absorbing and time-consuming that my overriding consideration was always 'what can I do on the computer?' rather than 'what do I want the computer to do?' I was so constrained by my technical shortcomings that I was unable to look beyond them to check whether the programs I was writing were a worthwhile use of pupil time or of the computer as a resource.

One important thing I did learn from my experiences with microcomputers at that time was just how sublimely 'user-friendly' were the old familiar tools of communication. With coloured pens and paper I could create images of considerable complexity and minute detail in a far shorter time than I required to program my computer and I could annotate these quickly and easily. In fact there seemed to be little I wanted to do with my computer that I couldn't do better or more simply by other means. Could it be that the sceptics had been right all along? Would the school micro be after all a nine-day wonder to languish alongside the reel-to-reel tape recorder in some dusty corner of the stock cupboard?

The computer's facility to interact

No, the excitement generated among pupils by even the least appealing software was a source of motivation not easily dismissed by anyone who had witnessed it. Belatedly, I turned my attention to identifying the particular features by which the computer was capable of adding significantly to the experience of children and which were difficult or impossible to realise by simpler means. Having isolated how computers were different from other media I could concentrate on exploiting these features in pursuit of my curricular aims.

The computer's facility to interact with people, to provide and respond to information and thus promote further interaction, seemed to have the greatest potential. I had of course known about this capacity from the beginning – even my original tables-testing program rewarded correct inputs and commented on the performance at the end of the test, but now I view each program primarily in terms of the particular kinds of interaction it can support as opposed to the information it contains or the way this is presented.

As teachers we engage in many kinds of exchange with the children we teach. Some of these are simple, others more complex. For example, the asking of a closed question and its response represents one kind of simple exchange, while the asking of an open question followed by the attendant response is an example of a more complex exchange. The latter kind are sometimes termed 'higher order' interactions. Such experiences are usually very demanding of teacher time, and require a very high level of co-operation from children not engaged in the activity if they are to be successful.

The interactive potential of the micro, when fully and creatively exploited, can be used to multiply the number of higher order interactions experienced by each child, thereby increasing the opportunities they have to engage in discussion and decision making. Transferring some of this burden of transaction to the computer not only increases the computer user's exposure to this kind of experience but releases the teacher to spend more time with other children.

Of course computers cannot replace the teacher. For example, they lack the capacity to respond intelligently, or to respond to emotional inputs among other things. Those of us who are interested in the processes by which children arrive at decisions or solve problems will have noted how few programs address themselves to monitoring just how children come to a particular decision. For much of the time we would be ignorant of the quality of interaction which was taking place at the computer, though this is equally true of most of the non-computer work taking place at any given moment in the classroom, but it is surely some comfort to reflect that a teacher at least can make an intelligent enquiry if the need arises.

By now it should be clear that I feel that teacher-programmers are likely to find their paths beset with problems – educational as well as programming ones – so why do I think the experience worthwhile enough to recommend it, as I do, to others? Perhaps after all there is little need for teachers to get involved in the intricacies of programming?

The need for some teacher programmers

Not every teacher, perhaps, but I can think of good reasons for having at least one teacher in every school who has some personal experience of programming. The first is very down to earth! Computer software is extremely expensive even when purchased through schools' computer centres. The vast range of possible applications makes a comprehensive software library out of the question and might even tempt individual teachers to 'pirate' commercial software on behalf of their schools. Even allowing for fund-raising activities most primary schools find it difficult to set aside money even for those software purchases which are substantially open-ended like LOGO, or can be used many times, like data base generators or word processor software. Therefore the many teachers who find the more specific software both effective and desirable aids to learning will find that their requirements will normally have to remain unmet.

In this situation, the ability of a colleague to write simple programs for specific needs would be most welcome. Although the process is very time-consuming, especially for the beginner, some facility does come with experience, enabling presentable programs to be realised in hours rather than weeks.

A further advantage of the teacher-programmer lies in his ability to tailor programs more nearly to his colleagues' needs. Instructions such as '. . . simply alter the data statements at line . . ' have an immediate brain-numbing effect on people who are not aware that programs written in BASIC consist of a series of instructions held at numbered lines, but hold no fear for the teacher-programmer.

Another reason for wishing to have a computer literate colleague on the staff lies in the programmer's ability quickly to assess the robustness of a possible software purchase. He will know what should have been done to protect the program from the normal excesses of youth, or inexperienced fellow teachers. Furthermore, any comments he may make like 'I could do that' very likely mean that the product is overpriced and probably sub-standard.

For the time being at least I feel that I have sorted out my aims in respect of computer use in my classroom. I see the computer as an ally in my endeavours to increase the amount of high order interaction in the classroom, and feel that my struggles in the programming arena have contributed not only to my resources for teaching but also to my developing philosophy of education. And it is for this latter reason that I value my experiences as a teacher-programmer so highly. By attempting to develop what for me at least were new teaching materials I was able to look at my teaching from a new angle, and the insights I have gained have contributed to a deeper understanding of my own ideas about the practice and purpose of primary education.

"When is a Game not a Game?" by The Staff

Parkside Centre, Manchester

The use of computers in Primary Schools should be as a tool to be used, rather than an area of study. They must be seen to actively promote many different areas of the curriculum.

In ongoing discussion at Parkside we have continued to evaluate the role computers have in our establishment, and the progress being made by computers, based around these generally accepted aims of education.

To encourage the effective use of language and number.
To develop self confidence and independence.
To help develop lively and enquiring minds.
To encourage children to apply themselves effectively to tasks and problem solving.
To enable pupils to question and argue rationally.
To develop an understanding of the natural world.
To develop attitudes to tolerance and caring for others.

We still, however, accept the role of computers in the areas of teaching and testing certain specific knowledge or skills. We do feel however that this should not be the sole or primary use of micros in Primary Schools.

We have noted over the past year that many more children are becoming computer sophisticated, having a much greater understanding of computers. This does tend though to be a greater understanding of computer programming and it could be very easy for children to go overboard on this aspect of computers and so not take advantage of many of the learning situations that may become available from the use of other possible computer areas.

For example – as programming tends to be a solitary task you get little or no social interaction. Self confidence can often be stunted if micro language is not completely understood and mistakes occur and there is very little two way contact when working with a computer.

We try to 'overcome this' by introducing these children to other possibilities either individually or in small groups. However for many children a visit to Parkside also brings about their first contact with any form of micro.

Learning through 'play'

Many children initially view our computers as 'games' machines, they expect the latest arcade type games to be available, something we have to talk about, but which they soon accept isn't the case. However, we reach the question 'when is a game not a game?'. Some programs that we use to develop key board skills for example do have an element of fun or competition, and may initially be played as a 'game'. We must therefore remember that a great part of early learning is through this 'play/game' type of situation, and on our observations the skills being put over in this way are quickly and successfully assimilated by the child. The children are further given the opportunity for more 'play' type exposure during lunchtimes.

Two examples of this type of program are 'Compass Points' and 'Cat and Mouse'. Both based on correct usage of the keyboard by pressing required keys as soon as possible. In 'Cat and Mouse' the main aim is keyboard recognition and the child is given the task of finding and correctly pressing the key as soon as possible, so developing hand-eye co-ordination and basic computer keyboard knowledge. In 'Compass Points' control over the movements is based on understanding of the cardinal points of the compass (N.E.S.W) and by pressing these keys at the correct time. In both programs it is not only the computer/child interaction that is important but also that interaction which takes place between children involved in the programs and those children learning through watching the interaction taking place.

Simulations

The move onto various simulations where the children are actively involved in the decision/discussion role affecting the situation and where there are no wrong answers, is a valuable aid to enabling the child to develop the skills of decision making and discussion. However these may be looked on as games by some children – perhaps connected to the vast range of 'Adventure games' currently available. One other aspect of simulation type games which is of value is their ability to use concepts gained in theory in a practical form, for example co-ordinates can be and are taught in the primary range and the program 'Slick' is based on the use of co-ordinates. However the basis of this program is designed to deal with environmental issues and although designed for 12+ children it can be and has been successfully used with 8+.

Each session of 2 to 3 weeks at Parkside varies according to the needs of the children arriving, but our basic philosophy is always constant. The children after an initial familiarisation period move onto working on a subject which interests them – children working with an interest become more involved and extension in all areas of the curriculum, both core and hidden, generally follows.

Programming 'games'

Frequently children wish to include some form of computer work in their study areas, and the programming of some form of 'game' quite often follows. They quickly produce outlines – loosely based on those they have seen outside school in commercial programs. After trying out some simple, limited pieces of programming they usually see what a tremendous task they have set themselves at which point they either become more determined to carry on and finish it or accept doing what they are able to and leave the rest as written thoughts.

Another area of programming used by the children is in the production of quizzes – usually as Data bases for the information they have acquired. Our most basic quizzes make some use of the QUIZ/MQUIZ programs. Here the children have to supply the question and alternative answers and no use of BASIC language is required. Children devise their own programs which may be cumbersome but illustrate their ability to use the computer at their own level of understanding. (See Primary Contact SI.2 for example of this type). Some children are however not satisfied with this type and wish to improve it using a variety of means and so developing a greater skill using the computer. Such improvements include a fresh screen for each question, coloured writing, different type size (Double height in MODE 7) sound cues and a time allowed per question. Some of these requiring the use of simple procedures.

The following example is of such a program which although not beautifully structured shows how children approach this type of program.

BASIC TYPE

```
250. PRINT "ANIMAL QUIZ"
260. PRINT
270. PRINT "WHAT IS THE NAME OF THE MALE
GUINEA PIG?"
280. PUT A$
290. IF A$ = "BLACKIE" THEN GOTO 300: ELSE
GOTO 270.
300. PRINT "HOW MANY CHICKENS HAS
PARKSIDE GOT?"
310. INPUT B$
320. IF B$ = "3" THEN GOTO 330: ELSE GOTO
300.
```

2nd TYPE

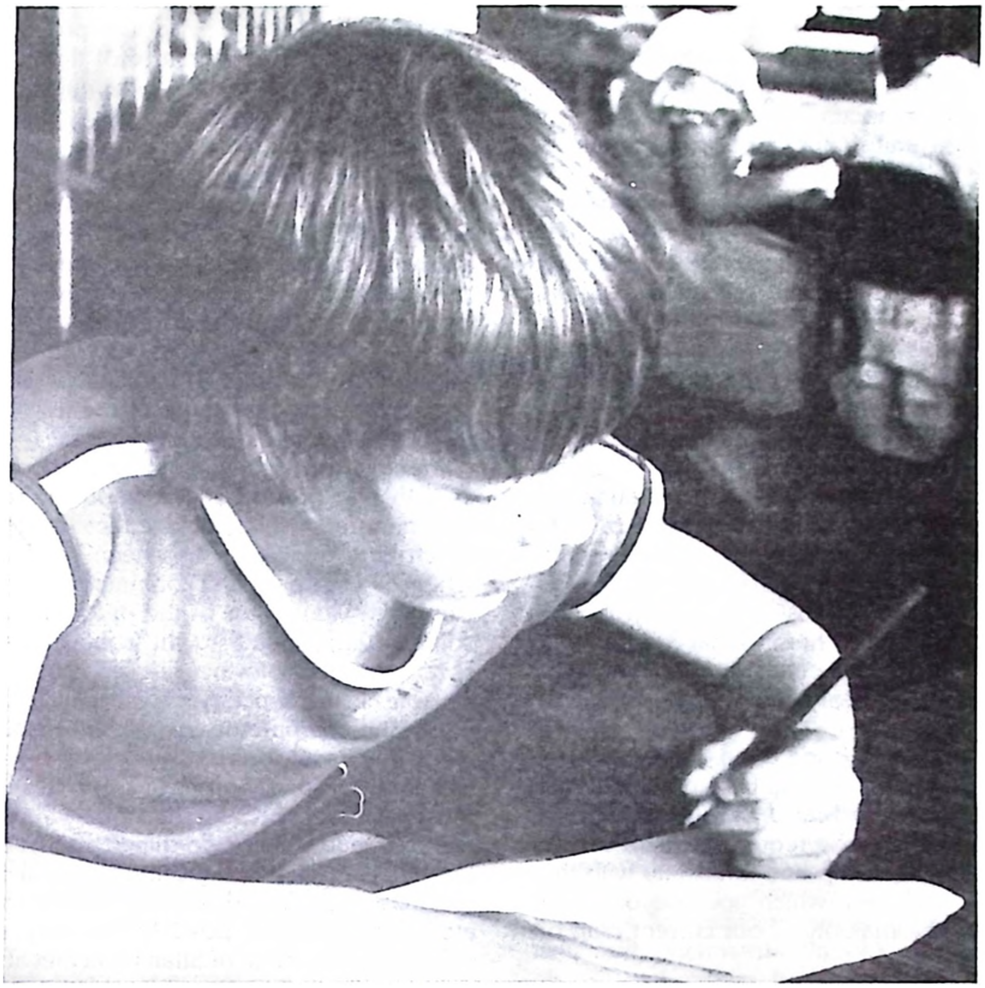
```
530. PRINT "ANIMAL QUIZ"
540. PRINT .........
550. PRINT "WHAT IS THE NAME OF THE MALE
GUINEA PIG?"
560. INPUT AA$
570. IF AA$ = "BLACKIE" THEN PRINT
     "CORRECT": ELSE PRINT "WRONG, THE
     ANSWER IS 'BLACKIE'. "
580. PROCTIMER
590. CLS
600. PRINT "HOW MANY CHICKENS HAS
PARKSIDE GOT?"
610. INPUT BB$
620. IF BB$ = "3" THEN PRINT "RIGHT" : ELSE
     PRINT "WRONG , THE ANSWER IS '3'."
630. PROCTIMER
640. CLS
```

3rd TYPE

```
930. MODE 7
940. PRINT CHR$ (129)" THE ANIMAL QUIZ"
950. PRINT CHR$ (129)"............ "
960. PRINT
970. PRINT
980. PRINT
990. PRINT
1000. PROCCONTINUE: SOUND 1, – 15, 155, 10
1010. CLS
1020. PRINT TAB (5,12); CHR$ (129) "WHAT IS THE
NAME OF THE"
1030. PRINT TAB (5,13); CHR$ (129) "MALE GUINEA
PIG?"
1040. INPUTTAB (5,15) AAA$
1050. 2$ = "BLACKIE"
1060. IF AAA$ = "BLACKIE" THEN PROCCORRECT:
ELSE PROCWRONG
1070. PROCTIMER
1080. PROCCONTINUE
1090. CLS
1550. DEF PROCTIMER
1560. FINISHTIME = TIME + 200
1570. REPEAT
1580. UNTIL TIME = FINISHTIME
1590. ENDPROC
1600. DEF PROCCONTINUE
1610. PRINT
1620. PRINT
1630. PRINT "PRESS ANY KEY TO CONTINUE"
1640. I$ = GET$
1650. PRINT
1660. ENDPROC
1670. DEF PROCCORRECT
1680. PRINT CHR$ (134) "YOU GOT THAT ANSWER
      CORRECT. " : SOUND.
       1, – 15, 81, 10: SOUND 2, – 15, 129, 10
1690. ENDPROC
1700. DEF PROCWRONG
1710. PRINT CHR$ (130) "THAT ANSWER IS
WRONG" : SOUND 0, – 15, 81, 10
1720. PRINT CHR$ (130) "IT SHOULD HAVE BEEN";
Z$
1730. ENDPROC
```

We believe that all children should learn to become masters of their tools. Where there is an interactive, cross curriculum approach to the use of computers in schools the prospect of adults with a symbolic relationship with these powerful tools is a real possibility and the adult dependent on reacting to a screens instructions a remote chance.

Although Parkside is a unique style of education, the continual interaction and discussion; between resident staff, visiting colleagues and educationalists, ensures that we are aware of and involved in developments in Mainstream Education.



"The Computer in my Life"

Some thoughts on the use of the micro computer in primary schools

by James M. Gent

Headmaster, North & South Killingholme Primary School, South Humberside

It is well known in the world of advertising that if you tell consumers often enough that such and such a commodity is necessary for the achievement of satisfaction, or happiness, or success, you will eventually convince them – the consumers – that it is so. What was once a luxury becomes a necessity. Increased sales, and competition from rival producers, brings about falling prices, and soon every home has one.

Such was true of tv sets, refrigerators, home freezers; and such is becoming true of video recorders and micro computers – in the last instance, much of the demand coming from children. Of these things I am assured by those who are supposed to know.

Certainly we found no difficulty in discovering 120 children of primary school age who possessed, or had free access to, a home based computer. For nine months we kept an interested eye on them, noting how competent they were – on the whole – in the use of school computers, and how they were able to explain some of the intricacies and mysteries of the machines to their friends. We then asked them some questions.

Let us admit from the start that some of the answers we received could, probably, have been predicted. The children were allowed to answer only 'yes' or 'no'. Later, some of the questions were expanded in order to allow more discussion, but these did not form part of the main exercise.

There were two parts to the questionnaire – the computer at home, and the computer in school.

In the home, half the children said they used it only for playing games; the other half said they used it for educational purposes as well. When analysed later, these purposes turned out to be spelling and arithmetic games, and a wide variety of quiz-type games which were incidentally educational, and had been bought with that purpose in mind.

All of the children thought that a computer was of itself educational. Seventeen per cent said that their parents used it more than they did; but we did not enquire for what purposes.

Surprising answers

It will have been noted that all of the children thought that a computer has some value in education. We therefore thought that the answers in the section relating to the computer in school were quite surprising.

None of the children thought that computers made lessons 'better'.
None of them thought that they helped understanding.
None of them thought that they could learn from them without the teachers' assistance.
None of them thought that they were absolutely necessary.
All of them thought that teachers would always be necessary.
None of them thought that computers were ever boring; but all of them thought that some teachers could be boring.

An almost equal number of boys and girls took part in the exercise, and we could determine nothing which indicated any preferences between the sexes.

It has to be stressed that these children were all aged between eight and eleven. It is certain that their answers were spontaneous, and uninfluenced by others; and they could, let it be re-emphasised, answer only 'yes' or 'no'. Probably it is not surprising that, without wondering why it should be so, all of them thought that a computer was educational; since that is almost certainly why the majority of parents provided them. What we thought remarkable was that all the children thought that computers were not necessary in school, but that teachers were.

We thought that this was a good thing. It seemed that teachers must be doing what they do best in a traditional way. But it may also have indicated that teachers have failed to come to terms with the requirements of today, and of the future. A relationship and familiarity with the computer must be developed, which goes beyond that presently enjoyed by the majority of our current crop of primary aged children.

Has the computer an important role?

We have to make up our minds about it. Either the computer in primary schools is an unnecessary, time consuming luxury, or it has an important, if not vital, role to play in preparing the child for what is to come later in his educational development. If the latter is true, then there is a need for someone on the school staff to be available to fulfil the child's needs in respect to the computer, just as much as in any other subject on the school curriculum.

If it is simply a luxury – defining as a luxury something which is expensive and unnecessary – the only sound argument for the appointment of a specialist teacher/technician is the saving of the time of other teachers, who presently can use the computer only after hours of precious time have been expended in preparing material for a use which, according to the children, is of questionable value.

Presumably the Government sees the micro computer in the primary school as a necessity, since it has done its best to ensure that every school has one. Yet the nettle has not been grasped firmly. It is like putting a piano in a room where there is no musician and expecting that all or some of the people in that room will become pianists. The fact that some may strike the keys, and even produce a recognisable collection of notes, does not achieve anything of importance.

The need for micro specialists

Computer skills must be taught by experts. A recent report suggested that there ought to be specialist teachers for all subjects taught in primary schools. The vital role the computer has, of being an extension of the teacher, can be achieved satisfactorily only if its role in a particular project is defined early, and necessary material prepared speedily. This can be done properly, and without disproportionate expenditure of time, only by an available teacher competent in such work.

I make no apology for constantly stressing that point. It cannot, in my opinion, be emphasised too strongly. It is no use any individual, or any body of people, expecting our children to become computer literate or numerate by accident or by good fortune. They must be taught, properly; and the teachers and other resources must be provided, if the knowledge and use of computers is to become a significant part of primary school life. Otherwise, let's stop pretending. Let us agree that in some schools some teachers and some pupils use a computer sometimes; and that some of them will learn something useful; but that most of them won't.

Frankly, most of the commercially produced software available at present is not good enough to justify the expenditure of invaluable educational time on its use. Much very good stuff has been produced – mainly by teachers – to be used in conjunction with tv programmes. Kept with video films of the programmes, the computer software appropriate to the subject has a useful life as library material, to be re-used from time to time in suitable circumstances.

But the computer in the classroom ought to be in use every day, in all sorts of situation, not merely brought out as a treat on special occasions. For this to be possible we must have that specialist teacher, so that, in time, children are able to 'do their own thing'; so that a class or subject teacher can take background material to the computer specialist and relatively quickly receive software appropriate to his immediate, possibly transitory, needs.

Not until this state of affairs is achievable can the micro computer in the primary school become as important as once was the slate and pencil.

Appendix

Please find underneath a copy of the questionnaire I devised and used. As you will see, it's very basic and unscientific; but it seemed to me to cover the sort of ground I wanted to explore. Naturally, I talked at some length with the children before they did it, explaining how they had to decide on a 'yes' or 'no' response. A few asked questions about that whilst completing the form, and they were given a nudge in whatever direction they seemed to be pointing. They were all 'my' children.

To question 1, 60% answered 'yes'; question 2, 100%; question 3, 83%; question 4, 60%; question 5, 40%; to question 6, 100% answered 'no'; questions 7 – 11 inclusive, 100% answered 'no' in each case. Ignoring irrelevant answers to question 12, several children opined that teachers were often not as interesting as computers – some used the word 'boring'.

I am sure that had the questionnaire been given a little after Christmas, when many of the children first received their machines, answers might have been rather different. After nine months, I felt, many were more than a little blase!

SOME QUESTIONS ABOUT YOUR COMPUTER

You must answer *YES* or *NO* to each of these questions.

1) Is the computer in your house your very own?
2) If the answer to Question No. 1 is 'No' – then can you use the computer whenever you want to?
3) Do you use the computer more than your parents?
4) Do you use it only for playing games?
5) Do you use it to learn things as well (like sums or

spelling, or quizzes)?
6) Do you ever get tired of playing with the computer? Is it *ever* boring?

This next part is about computers *in school*.
Remember, you can only answer *YES* or *NO*.

7) Do you think computers make lessons better – more interesting?
8) Do you think that computers help you to *understand* your work more?
9) Can you think of any subject that you could learn from a computer, without a teacher having to explain things to you?
10) Do you think that computers in schools are really *necessary*?
11) Think about all the things in school that help us to learn – radios, televisions, computers, and so on. Can you imagine a time when *teachers* will be unnecessary?
12) Now you can write down anything you would like to say about computers. Don't try to write too much.

The need for organising and evaluating software in the primary school by John Limbrick

Birmingham Microcomputer Primary Support Team

(This article is an extract from a dissertation presented as part fulfilment of the Diploma in Primary Computing 1984 Newman College).

The arrival of the micro has posed schools with new organisational problems concerning both the hardware and software. An improvement in the use of the software can be made by taking a few fairly simple steps. Firstly a school needs to organise its software to make it easily accessible to the staff. I have visited schools where the software is just thrown into a large box. With a few programs this system might be acceptable to some, but I have found that teachers will not use equipment or books if they cannot find what they want quickly. If each Micro Primer program is saved on to an individual cassette the school has immediate access to thirty-one tapes. It is surprising that some schools visited have not done this yet, so that teachers struggle trying to find the start of a program. It seems sensible to begin storing and cataloguing tapes in a way that is simple and easily understood. A large cassette case or box is a good solution for storing tapes. Each box should be clearly marked with the program's name, catalogue number, documentation number and approximate loading time. If the bottom of the cassette tray is also marked with the name of the program it might ensure that the tape is replaced in the correct position. Some teachers colour code for curriculum areas, a useful idea if the school possesses a large number of programs.

It is equally important to store the documentation correctly, as a program is useless without it and should not be kept. Two Satellite Schools I visited have written their own documentation on one side of A4 so that it will fit inside a plastic wallet to be placed in a ring binder. The documentation contains a brief description of the program, age level, management implications, and instructions on how to end the program, how to return to the start and how to recover the program if it appears lost. This is important information if the program is not crash proof. The documentation can be easily removed by the teacher. There might also be some suggestions on how to use the program and possible follow up work, links with other areas of the curriculum and other resources the school might possess. Both teachers who have rewritten their documentation explained that it had taken them a considerable amount of time. It is also a job that will need continual updating as new software arrives. They thought it worthwhile because it encouraged teachers to use a wider repertoire of programs more effectively.

One of the biggest problems for teachers is to see and evaluate enough software so they are aware of what is available for different areas of the curriculum. A well organised documentation folder as described above, will allow teachers to find programs in areas they are interested. Hopefully they will be encouraged to view the programs before using them, so that they can plan how they are used in class. If a head teacher is serious in his or her intention to encourage a more imaginative use of the software, teachers must be allowed time during the day to evaluate software. As the MAPE conference questionnaire disappointedly proved, very few schools do this. If time cannot be found for all the staff the person responsible for computing should have time set aside for evaluation, so that they can then advise staff on what software to use. In future schools will have a reasonably large library of programs. If the software is going to be used it must be properly organised, catalogued, documented and evaluated by the staff, or it will remain gathering dust.

On several occasions I have alluded to the teacher 'responsible for computing', but in many schools there is no-one who holds this position. I feel that it is extremely important that an interested teacher be given this post, even if other areas of responsibility are removed from their job specification. But what usually happens is that the computer is added to a list of already demanding roles. A new innovation such as the computer, will not succeed unless there is someone in the school who is encouraging its development as an integral part of the curriculum.

As well as maintaining the hardware and keeping the software in good order an important part of the job will be to monitor what programs are being used. Programs that are not being used should be discarded. It is more important to have a small library of useful software linked to specific areas of the curriculum than a large collection of programs that are rarely used.

Timetabling is another area which can influence the development of software. Initially the computer is placed in each class for a short period, usually a morning. At this point structured reinforcement programs that are easily handled and which support the present curriculum are often used. This is probably a reasonable use of computer time while staff and children are becoming familiar with the use of the computer. Many teachers feel that they do not have sufficient computer time to use the machine to its full potential. But there seems little point in rearranging the timetable and providing extra time if more of the same drill and practice type programs are to be used. If a school wishes to develop work with the computer and attempt more complex programs such as simulations and adventure programs, the staff as a whole have to make a conscious decision to allow longer periods with the computer, so that there is a continuity between sessions. This may mean that some classes will have the computer less often. This is where the post holder, with the support of the Head, will need all his or her talent for tact and persuasion. Unless these decisions are made the use of the computer will remain at a relatively simple level and its full potential will not be realised.

CONCLUSION

It is probably worth considering that two years ago few schools had a micro and there was very little software available. The rate at which the hardware has been introduced into schools has been phenomenally fast. The software has taken a little longer to catch up, but in the last six months there has been a large number of programs reaching the market, from the good to the awful. Some publishing companies have hastily put together a few programs to cater for the growing market of home as well as school users. Some have taken longer to develop their material, usually the larger simulations, others are standing back to see what happens. There is a feeling, articulated at the MAPE Conference by John Coll, that there is little money to be made from educational software. As one adviser commented "schools will have to be prepared to pay for good software". At present many schools have obtained most of their software free through the local authority and the MEP. But they must appreciate that soon they will have to start paying for software like other materials used in school. What have emerged are a few small companies, often run by teachers which are attempting to produce 'good educational software'. Some of these programs are poor but others like 4 MAT's Granny's Garden are very good and have become justifiably popular with teachers and children. But do schools need to spend a large amount of money acquiring a great many programs? I do not feel they do. I very much support the ideas of Anita Straker, that schools need three types of software; a library of small programs that support the existing curriculum, these will be linked to problem solving and investigation, plus structured reinforcement programs; simulations and adventure programs that encourage work across the curriculum for a period of weeks, these could be loaned from a central resources centre; flexible content free software which will have wide applications across the whole age and ability range of the primary school. Other advisers, from the replies to my letter asking them to recommend ten educationally worthwhile programs, obviously think this as well. This is a far cry from the sort of software that is being used in many schools. But a beginning must be made somewhere and it is sensible to expect schools to go through a familiarisation phase where a few drill and practice programs will be used, so that the whole class can 'have a go'. This period will not last long for some who will want to move to more demanding and complex programs, as can be seen from the sort of teachers who attended the MAPE conference. But not all teachers are as committed; the introduction of the micro has added something else to be dealt with in a busy day. Most teachers I have spoken to have very positive but perhaps limited views of the micro and its software, indicating the need for more software based courses. I feel there needs to be a period of consolidation for many schools. Those that have had their micro for a while, where staff and children are becoming familiar with a few programs and several teachers have attended courses other than the original D.T.I. course, should 'take stock' and consider what they need to do next. How should they organise the software; with which age level and ability groups should certain programs be used; what sort and type of programs should be obtained; how to develop what they have begun so that the potential of the computer can be realised.

School Policy Guidelines in Educational Computing by Mr. S.T. Hampson

(Deputy Head Teacher, Windlehurst C.P. School)

The need to provide direction to the development of Educational Computing in Primary Schools is an important issue which requires continued attention. It was and still is a curriculum innovation which has much to offer Primary Education.

However, if teachers and parents are to be convinced of its educational value, clear statements on the organisation, aims and objectives associated with this curriculum development need to be drawn up. More importantly, they need to be compiled with a view to the resources (both hardware and staff expertise) available within a particular school.

The headings considered in our school policy document we felt would be the main areas of concern for any Primary School undertaking this kind of curriculum development. They are essentially practical concerns and manageable objectives, which we feel reflect the 'reasonable' expectations for Educational Computing in our School.

One particular development which may be exclusive to our school, has been the start of a School Program Loan Scheme, by which programs made by or for our school are available for short-term borrowing. This has further strengthened our home/school links and given a new lease of life to C.A.L. as a curriculum development in our school.

Our school policy guidelines are offered as a help to any Primary teacher engaged in the process of devising similar staff reference documents.

Windlehurst County Primary School
Policy Guidelines in Educational Computing
Autumn, 1984

(A) General Statement of Aims:

1) *'Hands-on' experience* – To involve children in an interactive way, in successfully controlling the computer for their own learning needs. (The children involved range from the novice user to children with varying levels of programming ability).
2) Computer-assisted learning – To provide learning opportunities, through interaction with the computer as a learning tool and through simulation.
3) Computer-managed learning – To monitor learning by assessment, guidance and record-keeping.
4) Computer-assisted instruction – To transmit facts and skills by instruction, drill and practice.

(B) Specific Objectives (For staff and children)

These will be subject to revision as computer hardware specifications change, and expertise spreads among the children from 'home computing' experience.

1) The ability to set up the system ready for use – mainly staff and some older junior children.
2) Keyboard familiarity – location of letters and more common 'command' functions (PRINT, LOAD, COPY, RUN, LIST etc).
3) The ability to load and use 'ready-made' programs, including stopping, re-running and preparing the computer for new programs.
4) The ability to use the computer as a calculator.
5) The ability to make a copy of information displayed on the television screen, (program contents, test scores etc) – using the printer.
6) The ability to write a simple program.
7) To learn a 'working vocabulary' about computers in general – based on 'Talking about Computers' information card.
8) The ability to deal with user errors in loading and running programs (Deletion, 'breaking into' a program, re-loading etc).

   Depending upon the ability and experience of certain children, certain 'Higher Order Skills' will be developed concerning:
9) Programming and program editing.
10) Information handling and retrieval (data based programs).
11) Word processing.

By developing skills required for staff and children to effectively and efficiently control the computer as ..... a teaching/learning aid, it is hoped that the potential for educational computing can be both enjoyed and fully realised.

(C) Criteria for Success

The following criteria will be looked at in order to evaluate the success of this curriculum innovation. These can be assessed or tested at the beginning and end of a school year.

The number of staff and children able to:

1) independently set up the system, quickly, safely and easily.
2) complete a keyboard tester program (familiarity) with a score better than 75% on level 1 and 2.
3) complete loading and running of program tasks – without the aid of instruction (cards or teacher).
4) use the computer to solve problems using the four rules of number (x ÷ + –) – PRINT answers from the computer on to the T.V. screen – without the aid of instruction (cards or teacher) – use the computer as a calculator.
5) Produce a hard copy of T.V. screen information or score – without the aid of instruction (card or teacher).
6) produce original input in the writing of simple programs (two line programs initially) – and successfully run their programs ('Message' or 'Pattern-maker' programs used as 'starter programs').
7) Score better than 50% on general 'computer' quiz) – based on 'Talking about computers' card.
8) Deal with user errors (in program operation) – without the aid of instruction (cards or teacher).

(D) Constraints and Conditions

Resource constraint – Our one P.T.A. – purchased micro between seven classes requires timetabling of class access to this facility. This situation has been improved during the summer term (1983) with the delivery of a second Sinclair Spectrum (48K) purchased under the D.O.I. assisted purchase scheme.

Two are now available to each class during its timetabled period. If only one is used in a class, the other is released for individual or group work on a request basis.

No suitable fixed classroom base vacant – This has meant that the present use of the school computer has been conditional on the system being made easily portable. Our response to this has been to make our two systems portable in the following ways:

SYSTEM 1

P.T.A. purchased Spectrum micro (48K), cassette recorder, small printer, sound amplifier and leads (in use in 1982)	Transported in lined shock absorbent carrying case – system remains in case during use.
Portable T.V. or trolley T.V.	Transported separately.
4 way gang socket and lead.	Carried separately.

SYSTEM 2

D.O.I. Spectrum micro (48K), casette recorder, small printer, work station tray, monitor and Epsom full sized printer.	All transported on purpose built trolley – one mains lead – self contained system.

Areas to be allocated within each classroom – for setting up of the system, in such a way that other classroom activities can be continued as normal. – This arrangement does not involve the infant classes, a vacant adjacent room to their classrooms can be used.

(E) Methods and Media

Each class will have a minimum free access time of a whole day to use the school computers. Reception class usually start their regular timetabled period during the second term (Spring term), after the class has settled to class routine and work in the first term.

Because of larger class numbers and a greater percentage of independent readers in the 3rd and 4th year junior classes – they will be allocated a whole day each week as a timetabled period, with both System 1 and System 2 in use in their classrooms.

A series of school-made activity and work cards for the ZX Spectrum are available for use by each class for early 'hands-on' experience. Program software (commercial and our own) on casette is used along with documentation to accompany its operation. For display and teaching purposes large posters of the keyboard are also available for class use.

(F) School Program Loan System

Catalogue of school based software available (DIRECTORY):

1) to all pupils and staff.
2) to parents for preview and discussion.
3) to pupils and parents to take home to use (and copy) in the case of non-commercial programs made by or for our school.

A LOANS REGISTER is in use to 'check out' the programs borrowed. A static shelf unit is used for display and clerical work by 'School Computer Corner helpers'.

'WORKSHOP SESSIONS' – For parents wishing to find out more about educational computing in our school are held after school each week. (Wednesday and Friday – 3.30 to 4.30 p.m.) – Children from the upper junior classes are 'on hand' as experienced helpers during these sessions.

Micros & Early Learning by Ged Kennedy

Headteacher, Salford L.E.A.

Introduction

The early apprehension which was evident with the introduction of microcomputers into the primary school seems to have generally disappeared. It is also fair to say that the initial novelty has by and large faded away. It is now apparent that many teachers are giving a great deal of serious consideration of how best to integrate the 'new technology' into the curriculum, so that it might support, enhance and quite probably change the normal activities found in the primary school classroom.

In January 1984 I was instrumental in establishing a working party of teachers with the general aim of:–
"investigating the use of microcomputers in the early years of primary education, with particular reference to nursery school children."

This came about for a number of reasons not least the fact that Salford L.E.A. had been quick to respond to the opportunity of developing the use of the microcomputers in both secondary and primary schools. Salford incidentally have had for a number of years a strong commitment to nursery education, with some 90 nursery schools/nursery classes in its primary schools.

From a personal point of view I was anxious to develop the use of the micro with very young children to offset what seemed to be the growing tendency towards the older age groups in primary schools having a monopoly on computer time. This trend was understandable to some extent in that so much of the available software was aimed at the junior age range. There was also the belief held by some teachers that infant children, let alone nursery aged children would not be able to cope with the complexities of the computer keyboard without a great deal of adult assistance.

Aims Of Working Party

Against this background and with the support of the schools adviser for nursery education and the adviser for educational technology, I was able to get together a number of teachers involved in infant and nursery education who also felt a strong desire to explore the possibilities the microcomputer might offer.

There was no grandiose expectation that the working party would make any major contribution to microcomputer software or hardware development. Like most projects of this nature the real value is the shared experiences gained by the participants. These experiences, however, might then be relevant and of interest to other teachers in their own particular situation. Although it is anticipated that the teachers involved in the working party might play a role in the L.E.A.'s inservice programme, and might lend support and advice to other schools, the real benefits often came about through the unplanned informal contacts between professionals.

Observations So Far

At this early stage it is only possible to offer very tentative observations about the use of the microcomputer in the nursery. The following points however are ones that have general agreement amongst the teachers in the working party, who overall, from their experience so far, feel that the micro can make a positive contribution to the early years of education.

One technical note;

The following observations were made by teachers using the B.B.C. microcomputer. Although this need not detract from any of the observations it needs to be remembered when software is considered later on in the article.

1. Enthusiasm

Despite the uncertainty many teachers felt about how 3 and 4 year old children might respond, it was found that the vast majority showed a great deal of interest and enthusiasm. Very few children needed encouragement to use the micro, in fact most could not wait to have another go. The important point is however that this enthusiasm did not decrease as one might expect once the novelty had worn off. Clearly few children had the opportunity of using the computer every day, but nevertheless it was generally found that the same level of enthusiasm was sustained months after its introduction.

2. No fear Of The 'New Technology'

Together with the enthusiasm, it was evident that children showed little fear of the computer. Boys and girls alike had little hesitancy once they had been shown the key or keys to press. Children showed respect and did not treat the computer harshly, but having no pre-conceived ideas or fear of machines coupled with their natural curiosity, it made the introduction of the computer an exciting event.

3. Develops Co-operation

One practical thing children seemed to learn very quickly was that they could not all use the computer at the same time. As one teacher put it;

"using the computer encourages co-operation, sharing and taking turns. As soon as the computer was switched on a small crowd gathered, but they soon learned that only one or two children at a time could use it. The rest were quite happy to watch, discuss and wait for their turn to come."

It was also noticed that children helped each other. Newcomers to a program were often shown which keys to press by the children who had used the program before. In fact some of the 'animated action programs' (see later section on Software) worked very well with pairs of children working together.

4. Develops Concentration

It was found that the attention holding power of the computer was very good. This might have been expected in the early stages when it was still a novelty, but teachers agreed that even after prolonged use children showed greater concentration when using the computer than they did in most other activities.

5. Instant Feedback

Children enjoy making things happen on the screen. The instant reaction of the computer proved very motivating. One teacher remarked;

"there is an instant feed back with no perjorative tone of voice to interupt. The neutrality of the machine lessens the child's fear of making mistakes and it also may be a more valid indication of whether or not a particular concept has been grasped as the child does not have clues from the teachers intonation, facial expressions, bodily gestures etc."

The ability of the micro to respond instantly proved very attractive to all children.

"Even timid children are not afraid of failing, because they can't fail. Everyone can press a button to create and paint a flower even if they are too unsure of themselves to actually use paints."

6. Language Development

Opportunities for discussion between child and teacher and among the children themselves is greatly enhanced by the presence of the computer. One teacher remarked;

"the fact that there is an interested group gathered together with a common point of attention leads to a great deal of inter-group discussion. Individual children are also motivated to talk to the adult about the programs."

Children found the interaction between themselves and the computer so exciting and stimulating that even the most reticent of children would respond to the action on the screen. In fact many of the programs used by the working party were of an open-ended nature and depended on the discussion between teacher/child in order to be of real value.

7. Conceptual Development

Through the use of the micro and the all important discussion that comes from it, many basic concepts are developed in an interesting and exciting way. Colour recognition, discrimination of shape, sequence and logical order are but a few of the numerous concepts developed. Clearly the computer can never take the place of the essential concrete experiences children should engage in during this stage of their development, but it does make a very useful bridge between the more representational abstractions that they will later encounter.

The very act of operating a computer also develops the child's spatial awareness, orientation, memory, as well as finer motor skills.

8. Development of Independence

Many of the teachers in the working party remarked on how impressed they were with the independence shown by many children. Even quite shy children showed a great deal of autonomy, once they had understood how to use a particular program.

9. Growing Up With Microcomputers

A general observation made by a number of teachers involved in the project was the importance of children growing up with the computer. It is obvious that the children in nurseries now, are going to encounter the computer more and more in their school life and after, although it is recognised that the activities the child is involved in while using the computer should be 'worthwhile'. As one teacher expressed it;

"Is the fact that the child is naturally becoming a more sophisticated computer user just as valuable as the concepts he or she is exposed to?"

10. Some Limitations

A number of limiting factors were identified. The first concerns lack of computer time. In a primary school with one or two micros to go round, the best that could be expected was for the nursery to have the use of a computer on half a day or one day a week. Like any other shared resource this was usually timetabled. Due to this some teachers found it difficult to build up any continuity. It is not suggested that the computer should be in use all day every day, but greater flexibility is needed to obtain the freedom to use the computer if and when the opportune time arises.

Although many children do quickly show a measure of independence in using the computer, most teachers found that to get the best out of its use, a large amount of teacher time was required. This could be overcome by getting mothers or older children to assist, but one or two teachers have expressed some reservations about whether the time spent setting the computer up, and using it, is proportionately acceptable to the benefits gained.

Despite the surprising adaptability of the children in using the micro it must be conceded that the conventional keyboard does present something of a problem. Similarly, computer equipment and furniture was not designed with the young child in mind.

Most of the above observations were made by the teachers in the working party after a relatively short period of time. Some of the points concerning the limitations are practical ones, and in fact do not take into account some of the peripheral equipment now being evaluated by the working party. The concept keyboard in particular promises to remove many of the problems inherent in the conventional keyboard. It is also apparent that the practical problems of setting the computer up in the nursery become less pronounced once teachers get into a routine. Nevertheless there is still a need for computer furniture to be more adaptable in order that even the youngest of users can work comfortably and safely.

Software

The reader will have noticed that no mention of particular programs has been made. This had been done deliberately for a number of reasons. It was found that many publishers of computer software were reluctant to send programs out on approval. This now seems to be changing, but at the time of starting the working party this presented a problem. The few software houses that did offer programs on approval usually allowed a month before purchase or return. It clearly was difficult for a number of teachers to get the time to give them rigorous classroom testing. Similarly the practice of some publishers to leave copies of their software at teacher's centres and MEP regional offices so that they can be viewed is better than reading about them, but offers no substitution for the acid test of children trying them. This problem was overcome however by distributing amongst the working party programs that did not have any copyright restrictions.

Through MEP and SEMERC quite a number of programs were obtained, and were evaluated after use by the group. This not only had the advantage of acquiring programs at little cost, but it also allowed all the teachers in the working party to try the same programs. It was then interesting to compare the different reactions to the software.

A list of programs that have no copyright restrictions can be found at the end of the article.

More recently the working party have reviewed a number of commercially produced programs, some good, some bad, and some indifferent. It would be wrong of me to recommend any of these programs, simply because they have not been given sufficient examination and any comment made would be a purely personal one.

What might be more useful is to highlight a number of points that have emerged regarding software for children in the early years, which teachers might consider before purchasing programs.

1. The first one is a rather obvious one in that compared with other age groups there are still very few programs for the pre-five year old age range.

2. Leading on from this is the fact that much of what is available in this age range is aimed at the home market and not at schools. The criteria of what is 'good' may well differ between parents and teachers. What is suitable for home use may well not be what precious capitation money should be spent on. Similarly what might be useful in school for many children to use may often be unsuitable for one child at home.

3. It is a wise move not to be taken in by names; i.e. names of publishers or names of program. Many reputable book publishers are now producing software, but the software some are producing does not stand alongside their written publications. If I might indulge in an anecdote for a moment to make the point.

I came across a program by chance, which on the front of it's beautifully produced library case stated:– age range 4-6 years. It was called after a well known cartoon character bearing the same name as a London railway station. Accompanying the cassette with programs on basic shape and colour skills was a story book. The publisher was known to me as one with an excellent reputation for producing school text books. So far so good. On running the program I was first of all rather disappointed by the poor screen layout. I was then dismayed to see such words as, magenta and cyan used in the colours program and rectangle, oblong and oval used in the shapes program. When I ran the words program I was amazed to see a guess the word/hangman type game, but astounded at the words the child had to guess. These included; Jonathon, Portabello, marmalade, accounts, scrapbook, sandwich, suitcase, and beartrap. I admit that they are linked to the character and the accompanying story book, and I also realise that the package is aimed at the home market where the interested parent might sit with his/her child and work through the programs, but where the relevance for the child of 4 or 5 comes in I was at a loss to see.

4. Teachers are well advised to be cautious of programs that claim to have a suitability for a wide age range. If a program states that it is suitable for children from the age of 3 upwards, what this usually means is that there are different levels of difficulty starting with the very easy. What many of these programs do have is rather complex screen layouts, which are totally unsuitable to the pre-reader. A child of nursery school age is not interested in messages such as "try again", "hard luck", "well done Christopher you got 9 correct in 10 attempts".

5. Documentation or teachers notes should be provided either in written form or in the introduction to the program. Programs that display instructions while the child is actually involved in the activity should be avoided. The child of nursery school age requires clear simple displays with no distracting instructions to get in the way.

6. Is the program child-proof? Try pressing all the wrong keys to find out. There is nothing more infuriating than having to re-load the program because an inquisitive finger has pressed the Break key. Also of major importance is that the auto-repeat facility should be dis-abled. Young children do not have the lightness of touch, and to expect them to use the Delete key is unnecessarily complicating matters. Teachers should also look for options for sound level. With older children some programs need no sound at all. With the younger child sound is important, but should be controlable otherwise, it can become a distraction, and what's more, grating on the teacher's nerves after a day of the same old jingle.

7. Teachers should consider how the subject matter of the program will fit into their overall scheme of things. There seems little point in doing an activity in isolation that cannot be built upon or extended.

8. The final point concerns programs on cassette (the vast majority at the moment). How long and how easy is it to load the program? If I might break my silence on mentioning a commercially produced program; E.S.M.'s 'Colour Matching' is a very good suite of programs. It is well structured and well presented offering very useful work for the early learner, but it is difficult to load in that it loads in sections and takes a few minutes of valuable time to locate and load the appropriate level for the individual child. This will not be a problem for disc users, but at the moment the vast majority of teachers have cassette based systems, and loading programs from cassette can be a very tedious affair.

In Conclusion

I would not want the reader to think that this article is a definitive statement about the use of microcomputers with nursery aged children. It is meant to be a description in the briefest terms of the experience of a small group of teachers who have spent some time exploring this new and exciting area of education.

In looking towards the future it would seem that the use of microcomputers will inevitably grow in all sectors of education including use by even the youngest of children. With this growth will come a development in equipment and refinement of practice.

In the next year or so most schools will have disc drive facilities. Many will have print-out facilities. There will also be a development of peripheral equipment such as the concept keyboard. In addition to this it will be interesting to see the developments that will take place in LOGO and also speech synthesis. All these developments will influence the use of the micro with the child in the early years of learning. In order however that these developments in hardware and software enhance the learning opportunities for children, it is necessary that teachers inform themselves about microcomputer technology and commit themselves to the use of it. As with any other aspect of the child's education the most important single thing is the quality of teaching. No amount of high technology can replace this. In order to sustain the quality of teaching it is necessary that teachers use to good effect all the available resources. It is my belief that more and more teachers will begin to see the contribution the microcomputer can play in the education of children in the nursery school.

List Of Software With No Copyright Restrictions

Teachers who are thinking of using the micro for the first time with nursery school children may find the following programs useful. They can be obtained from the regional offices of MEP and SEMERC for the cost of cassette tape or disc and the cost of photocopying the accompanying documentation.

Available from MEP:-

Eresby Special School Programs-

- DRESS
- BOTTLES
- SING 6
- HOUSE

West Midlands Special Education Project-

- COLOURSNAP
- CANNONBALL
- KICKABRICK
- POSTMANPAT (needs adult assistance)

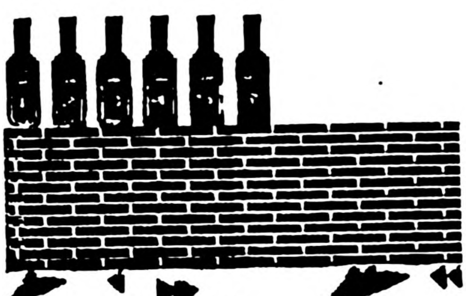
From SEMERC:–

Derek Harrison's Compact System Of Programs

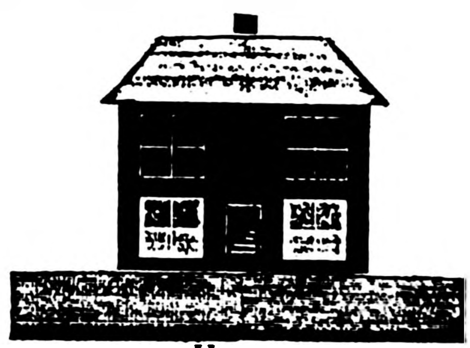
The above mentioned suite of programs were written for the teaching of profoundly and severely mentally handicapped children and adults. They were designed for use with various peripheral switch systems, and concept keyboard. The single and multi-switch programs will however work on the normal computer keyboard, but require minor changes if only the 'Return key' and 'Space Bar' are employed.

The subject matter of the programs proved very useful with nursery children. Many of the programs draw pictures of familiar objects such as flowers, cars, vans, planes etc, while the 'animated action programs' use stick figures to produce a variety of actions e.g. walking, running, throwing, jumping. Because the programs are open-ended they require some degree of teacher input in order to get the best out of them, although many children were quite happy to press the Space Bar and watch what happened.

Screen Displays Of Some Of The Non-Copyright Programs

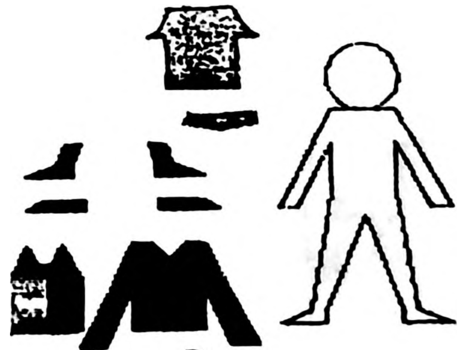


Bottles



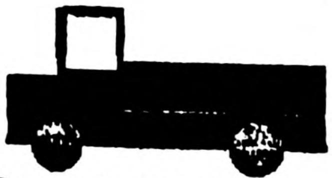
House

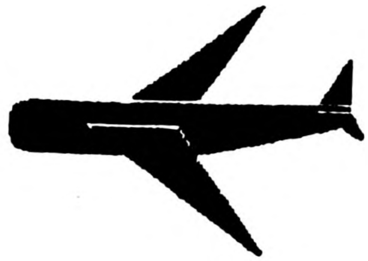
Crow



Dress

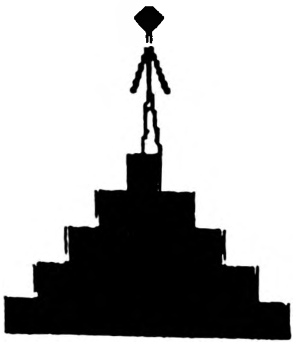
Compact System Of Programs





Drawing And Painting Programs

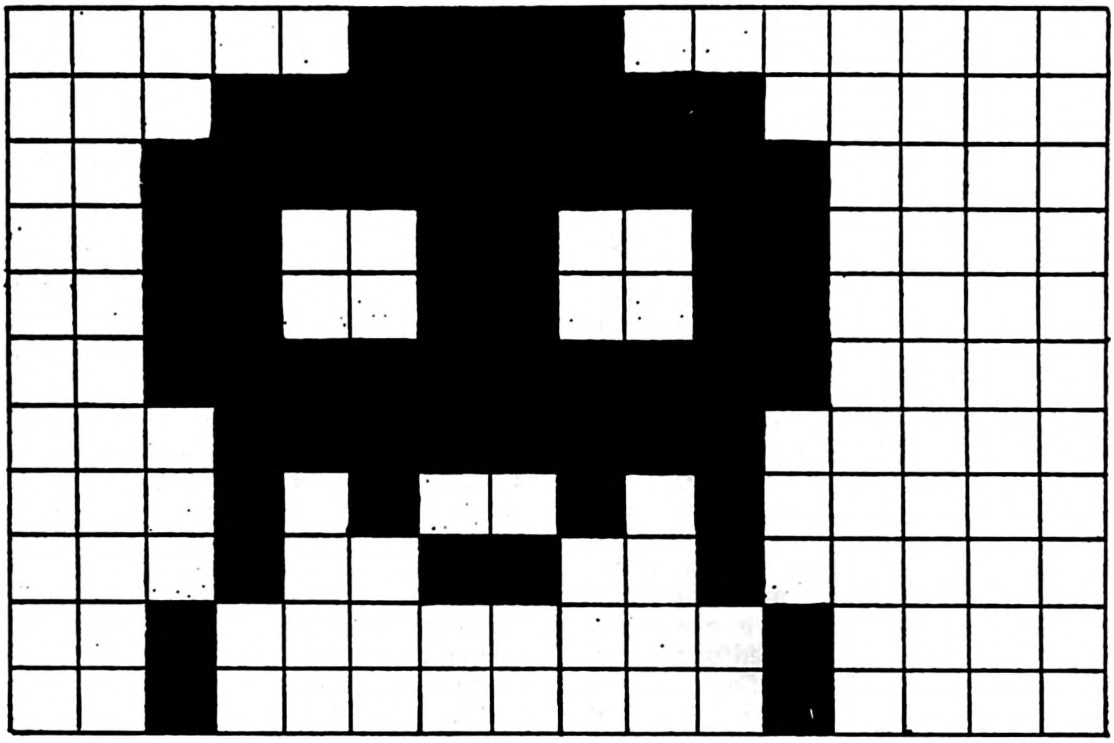
Animated Action Programs



A Final Note
If any reader is interested in the development of microcomputers in the early years of learning or wish to give the benefits of their experience to the working party, I would be pleased if they contacted me at:–

Clifton Green Primary School,
Silverdale,
Swinton,
MANCHESTER M27 OQP

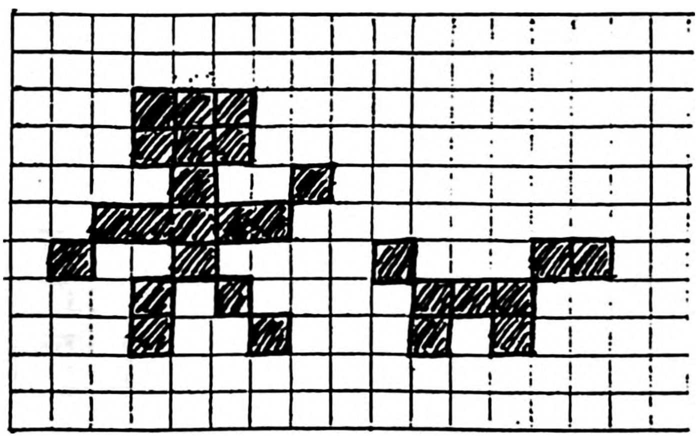
Tel :-061-794-3000

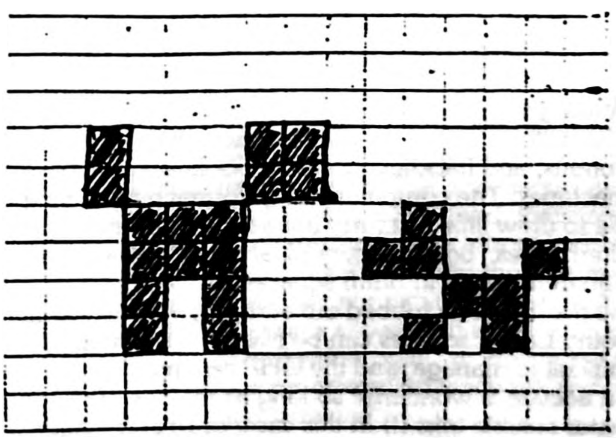


More Pre-Computer Activities with Sprites and Ceefax by Dorothy Diamond

The numbers in primary schools are rising again, so the chances of hands-on experience with the school's precious computer, or even computers, may still be rare. And as in the days when the Book of Proverbs was compiled, it is still true that hope deferred maketh the heart sick – so the more and better the pre-computer activities we can provide, the less frustration will be felt all round.

Children, both at school and at home, have opportunities to watch BBC Ceefax in colour, and this opens up a wide range of ideas and things to do – closely related to computer graphics which is the method by which the displays are produced. Here is a resource far too good to be missed. Just as the adult designers invent the shapes of letters, numerals and symbols which appear on the screen, so can children make their own designs on squared paper. They will be able to see how similar the two techniques are, especially if they actually copy a few of the Ceefax – or Oracle – items from the TV screen itself. This can be encouraging when they realise that the designers had to do it on a squared grid first – and the activity gives every pupil a chance to be original, inventive, 'problem-solving' – while at the same time producing a permanent piece of work which can be added to a file or exhibited on Parents' Evening. The designs can be executed on centimetre-squared paper, on 5-millimetre squared paper (much more easily found in stationers' shops) or on peg-board with the usual round-headed plastic pegs.





Two new ideas come immediately from this – the first is that the peg heads make letters, numerals etc. in the same way as the full-sized electric light bulbs do on motorway signs and Underground platform indicators, or Light-Emitting Diodes (LED) in some pieces of computer-type technology. The second concept, of wide importance, is that the larger the unit in the design process e.g. the centimetre square, compared with the smaller 5mm square, the more difficult is it to 'draw' curves and slopes. A recent series of cigarette advertisements has shown this problem brilliantly – with a man beside his sports car, beside a steamroller, and sitting in 'his' lounge with pictures on the wall; if back issues of Sunday supplements are available, the cigarette advertising can be cut out, and the designs used to great effect. One has to work hard, from a distance, to identify the last of these pictures. But the real point is of daily importance to photographers and screen-printers – as it was to the Pointillist painters – the coarser the 'units' – dots or squares, the less the precision of outlines i.e. the 'definition'. To try this out for themselves, children only have to look at the football in the Ceefax 'Sport' headline, to copy it exactly by counting squares on to centimetre squared paper, and then to draw an equal-sized football on 5mm squared paper. The nearer approach to roundness in the second is quite striking. Then two further pieces of observation can be used to check on this result: the first is to look closely at a large printed poster to see how flesh-tints are made up of small dots of very peculiar colours.. and then to look closely at the images on the colour television screen! The extremely small dots of colour can again be identified – and if the set is not exactly tuned, separate dots of one colour can often be seen as a 'fringe' along one side of each image.

Colour and computer-type graphics

The Ceefax pages display a standard set of colours, as does the TV test 'card'. These colours are black, blue, red, green, cyan, magenta, yellow and 'white', this last on a Visual Display Unit (VDU) simply wiping out whatever colour was there before. It is well worth while collecting a set of felt-tip pens to match the computer 'palette' of these colours; many people are not familiar with cyan – light rather acid greenish-blue – and some do not at once know magenta, the pinkish-purple colour quite often seen as a kind of 'shadow' beside TV pictures. Once children know that these colours are important i.e. that these are the only colours a computer screen or a colour TV set can produce, then they are quickly able to identify and name them, and to use them (only) to colour their own computer-type pictures. It is to be hoped that the school suppliers will one day get around to making up sets of these colours in felt-tips; at the moment they seem to think that a 'palette' is a flat sheet of wood with a thumb-hole in it, though every TV shop shows the real thing in the window for hours each working day.

What graphics?

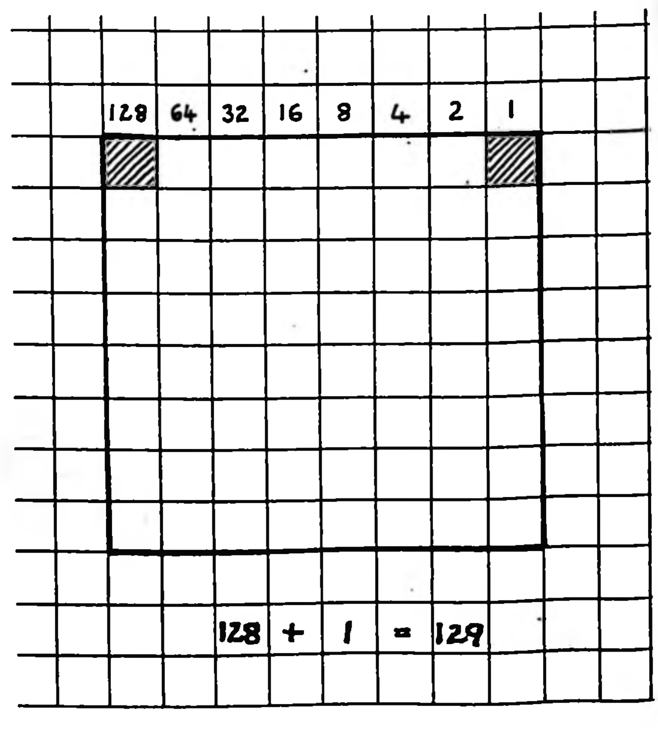
The little 'aliens from outer space' have become ubiquitous, and hackneyed – from book-jackets to snackbar machines. The computer screen format makes it impossible to draw little soft furry animals, but there are pleasing alternatives, both humanoid and recognisably pet-like. Squared paper, in 5mm squares, and an ordinary pencil (so that it can be rubbed out easily) make the best starting point. Larger squares can be filled in if the small ones are difficult to manage, and the OHP centimetre squared grid on acetate is wonderful so long as the pens only contain water-soluble inks (!) In this case, cyan and magenta will probably be very hard to find, but a damp tissue provides exactly what 'white' would be on the computer palette.

The 'creatures' of the computer game are called 'sprites', which seems to make them more attractive, and every pupil can invent his or her own (static) sprite on paper. Their size can be controlled by setting a definite area, say 8 × 8 squares; each square inside this is a 'pixel' in the jargon, from *Picture Element*. The jargon word in this case has its use, since it is far neater to say than 'one of the little squares inside the big square.'

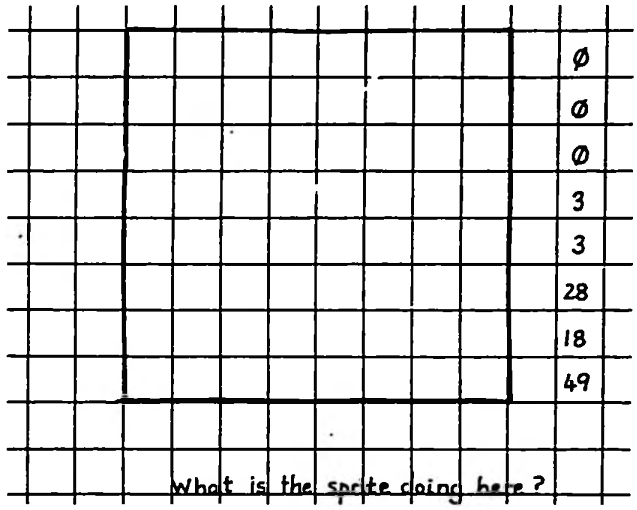
Placing the pixel

The computer screen (VDU) is organised invisibly into a grid of almost-squares, each of which has its own individual 'address', of the same type as the arrangement on a street plan of a town. The squares on paper or OHP acetate grid can be numbered, and each square to be filled in with colour to draw a sprite can be named by its two reference numbers. The only problem here is that in one mode the numbering may be 'along the top, then down the left-hand side', or (as in the BBC graphics mode) 'along the bottom, and up the left-hand side', as one would put in the values for a mathematical graph. The best thing is to decide in advance which form to use, and work with that one only. When this is settled, one child of a pair can give the address of a square – say '6 along, 8 up' – and the partner fills this in. The method is exactly the one they have used for years in playing 'battle-ships', if they have played battleships.

However, in computer graphics designing, there is a much more sophisticated variation, involving binary numbering of the pixels. In this form, to define the pixels inside a square for a sprite, the binary numbers are written along the top of the larger square, starting with 1 at the top right, then 2, 4, 8, 16, 32, 64, and 128 from right to left. Then the values of the pixels to be filled in are named, horizontal row by row, outside the square on the right-hand side. For example, if the two top corners of an 8 × 8 space are to be filled in, the instructions at the right-hand side on the top line will be 1, 128 or 128,1. This is a method which attracts pupils who have grasped the base 2 idea, and who enjoy playing with skills they have learnt; those who have not become confident in the



binary code have only to look at the top line, and practise. The step after that is to add up the binary code values in decimal for each line; the two top corners now become 1+128 i.e. 129. There is only one way to obtain this single value; written out in full it would be 128, 0, 0, 0, 0, 0, 0, 1, and this could just as well be signalled by lighting up the two end bulbs in a line of 8 electric lights. Such activities can be developed from the simple drawing of sprites, letters and numerals (so-called alphanumeric characters) using a grid of ordinary squared paper; some of these ideas, and others, are described in a series of three pupil books called Get Ready for the Computer, to be published by Hulton Educational in Spring 1985.



Another Look at Primary Maths with a Micro by Anita Straker

The trouble with writing articles – apart from the time it takes – is that once in print you are committed for ever. The other day, while rummaging through a drawer long overdue for a spring clean, I came across a piece I had written nearly two years ago. It was called Primary Maths and the Micro and it eventually appeared in several places, including a MUSE special report, with an abridged version in The Times Educational Supplement. As I browsed again through the article it occured to me that if it had been written on paper that would automatically self-destruct after a fixed period of time then the evidence of my thinking two years ago would have neatly disappeared and I could start afresh!

Looking back, maybe the emphasis of the article was reasonably appropriate at the time. The Cockcroft report on the teaching of mathematics in schools had been published in the previous year but, understandably, had made little reference to the possible impact of the use of the micro in primary schools. The report, in its well publicised paragraph 243, emphasised the need for a balance in the mathematical learning opportunities offered to children:

- ★ exposition by the teacher;
- ★ discussion between teacher and pupils and between pupils themselves;
- ★ appropriate practical work;
- ★ consolidation and practice of fundamental skills and routines;
- ★ problem solving, including application of mathematics to everyday situations;
- ★ investigational work.

In my article I considered examples of software which could contribute to the balance which Cockcroft had highlighted, particularly those programs which would stimulate mathematical discussion between groups of children, and those which would enhance opportunities for investigation and problem solving.

At the time, I think my main purpose in writing about the micro and primary mathematics in that way was to encourage teachers who were beginning to use a new resource in their classroom to look beyond the practice material with which we were (and still are) being inundated. I had in mind one of the aims set out in the HMI discussion document Mathematics 5-11: "to develop an understanding of mathematics through a process of enquiry and experiment". I believed then (and still do) that for teachers who do not feel very confident, either about using a micro or about teaching mathematics, there is a range of small programs which are both extremely easy to operate and educationally valuable. The SMILE program TAKE HALF is a good example since it requires no more than the typing of LOAD and RUN, with a press of the space bar when a pause in the film is required, yet a great deal of creative mathematical activity can arise out of its use in the classroom. The software catalogue included in the teacher training pack *Primary Maths and Micros*, and issued free to LEAs and colleges by the MEP Primary Project, includes many other examples of good mathematics programs which are similarly easy to use.

However, towards the end of my 1983 article there is a conclusion that "there is only a handful of programs which allow young children to undertake mathematical activity at the computer in a truly investigative way." It occurs to me now that this fact really may not matter very much!

We know from the outcomes of small surveys that approximately 40% of primary aged children have a micro at home, although the figure varies from one area to another. The two major activities by 8 to 12 year olds who use micros at home are apparently programming (in BASIC) and playing arcade games. We also know that primary teachers in nearly every LEA (and therefore presumably children in school) are being introduced to the programming language LOGO, usually through the use of a turtle graphics sub-set contained in a program like ARROW or DART. Perhaps all we need to encourage more mathematical investigation with a micro is a machine equipped with a programming language and a collection of ideas as starting points?

Two new ideas come immediately from this – the first is that the peg heads make letters, numerals etc. in the same way as the full-sized electric light bulbs do on motorway signs and Underground platform indicators, or Light-Emitting Diodes (LED) in some pieces of computer-type technology. The second concept, of wide importance, is that the larger the unit in the design process e.g. the centimetre square, compared with the smaller 5mm square, the more difficult is it to 'draw' curves and slopes. A recent series of cigarette advertisements has shown this problem brilliantly – with a man beside his sports car, beside a steamroller, and sitting in 'his' lounge with pictures on the wall; if back issues of Sunday supplements are available, the cigarette advertising can be cut out, and the designs used to great effect. One has to work hard, from a distance, to identify the last of these pictures. But the real point is of daily importance to photographers and screen-printers – as it was to the Pointillist painters – the coarser the 'units' – dots or squares, the less the precision of outlines i.e. the 'definition'. To try this out for themselves, children only have to look at the football in the Ceefax 'Sport' headline, to copy it exactly by counting squares on to centimetre squared paper, and then to draw an equal-sized football on 5mm squared paper. The nearer approach to roundness in the second is quite striking. Then two further pieces of observation can be used to check on this result: the first is to look closely at a large printed poster to see how flesh-tints are made up of small dots of very peculiar colours.. and then to look closely at the images on the colour television screen! The extremely small dots of colour can again be identified – and if the set is not exactly tuned, separate dots of one colour can often be seen as a 'fringe' along one side of each image.

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What graphics?

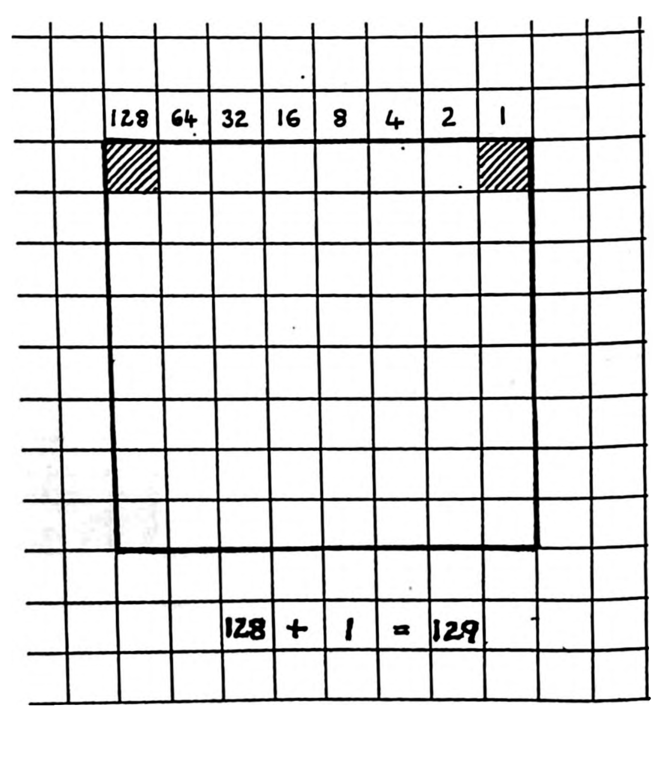
The little 'aliens from outer space' have become ubiquitous, and hackneyed – from book-jackets to snackbar machines. The computer screen format makes it impossible to draw little soft furry animals, but there are pleasing alternatives, both humanoid and recognisably pet-like. Squared paper, in 5mm squares, and an ordinary pencil (so that it can be rubbed out easily) make the best starting point. Larger squares can be filled in if the small ones are difficult to manage, and the OHP centimetre squared grid on acetate is wonderful so long as the pens only contain water-soluble inks (!) In this case, cyan and magenta will probably be very hard to find, but a damp tissue provides exactly what 'white' would be on the computer palette.

The 'creatures' of the computer game are called 'sprites', which seems to make them more attractive, and every pupil can invent his or her own (static) sprite on paper. Their size can be controlled by setting a definite area, say 8 × 8 squares; each square inside this is a 'pixel' in the jargon, from *Picture Element*. The jargon word in this case has its use, since it is far neater to say than 'one of the little squares inside the big square.'

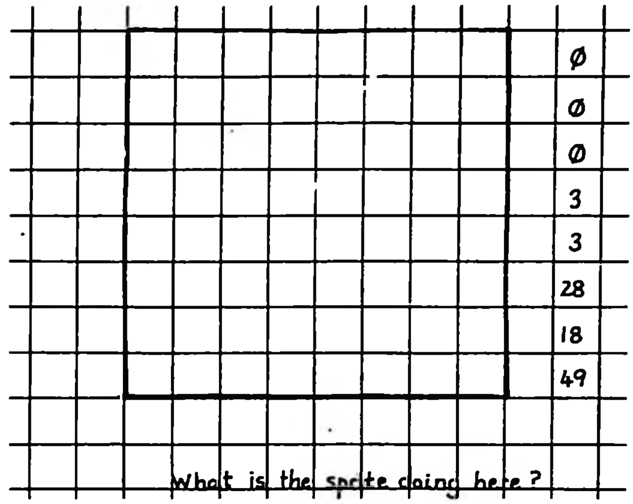
Placing the pixel

The computer screen (VDU) is organised invisibly into a grid of almost-squares, each of which has its own individual 'address', of the same type as the arrangement on a street plan of a town. The squares on paper or OHP acetate grid can be numbered, and each square to be filled in with colour to draw a sprite can be named by its two reference numbers. The only problem here is that in one mode the numbering may be 'along the top, then down the left-hand side', or (as in the BBC graphics mode) 'along the bottom, and up the left-hand side', as one would put in the values for a mathematical graph. The best thing is to decide in advance which form to use, and work with that one only. When this is settled, one child of a pair can give the address of a square – say '6 along, 8 up' – and the partner fills this in. The method is exactly the one they have used for years in playing 'battle-ships', if they have played battleships.

However, in computer graphics designing, there is a much more sophisticated variation, involving binary numbering of the pixels. In this form, to define the pixels inside a square for a sprite, the binary numbers are written along the top of the larger square, starting with 1 at the top right, then 2, 4, 8, 16, 32, 64, and 128 from right to left. Then the values of the pixels to be filled in are named, horizontal row by row, outside the square on the right-hand side. For example, if the two top corners of an 8 × 8 space are to be filled in, the instructions at the right-hand side on the top line will be 1, 128 or 128,1. This is a method which attracts pupils who have grasped the base 2 idea, and who enjoy playing with skills they have learnt; those who have not become confident in the



binary code have only to look at the top line, and practise. The step after that is to add up the binary code values in decimal for each line; the two top corners now become 1+128 i.e. 129. There is only one way to obtain this single value; written out in full it would be 128, 0, 0, 0, 0, 0, 0, 1, and this could just as well be signalled by lighting up the two end bulbs in a line of 8 electric lights. Such activities can be developed from the simple drawing of sprites, letters and numerals (so-called alphanumeric characters) using a grid of ordinary squared paper; some of these ideas, and others, are described in a series of three pupil books called Get Ready for the Computer, to be published by Hulton Educational in Spring 1985.



Another Look at Primary Maths with a Micro by Anita Straker

The trouble with writing articles – apart from the time it takes – is that once in print you are committed for ever. The other day, while rummaging through a drawer long overdue for a spring clean, I came across a piece I had written nearly two years ago. It was called Primary Maths and the Micro and it eventually appeared in several places, including a MUSE special report, with an abridged version in The Times Educational Supplement. As I browsed again through the article it occured to me that if it had been written on paper that would automatically self-destruct after a fixed period of time then the evidence of my thinking two years ago would have neatly disappeared and I could start afresh!

Looking back, maybe the emphasis of the article was reasonably appropriate at the time. The Cockcroft report on the teaching of mathematics in schools had been published in the previous year but, understandably, had made little reference to the possible impact of the use of the micro in primary schools. The report, in its well publicised paragraph 243, emphasised the need for a balance in the mathematical learning opportunities offered to children:

★ exposition by the teacher;
★ discussion between teacher and pupils and between pupils themselves;
★ appropriate practical work;
★ consolidation and practice of fundamental skills and routines;
★ problem solving, including application of mathematics to everyday situations;
★ investigational work.

In my article I considered examples of software which could contribute to the balance which Cockcroft had highlighted, particularly those programs which would stimulate mathematical discussion between groups of children, and those which would enhance opportunities for investigation and problem solving.

At the time, I think my main purpose in writing about the micro and primary mathematics in that way was to encourage teachers who were beginning to use a new resource in their classroom to look beyond the practice material with which we were (and still are) being inundated. I had in mind one of the aims set out in the HMI discussion document Mathematics 5-11: "to develop an understanding of mathematics through a process of enquiry and experiment". I believed then (and still do) that for teachers who do not feel very confident, either about using a micro or about teaching mathematics, there is a range of small programs which are both extremely easy to operate and educationally valuable. The SMILE program TAKE HALF is a good example since it requires no more than the typing of LOAD and RUN, with a press of the space bar when a pause in the film is required, yet a great deal of creative mathematical activity can arise out of its use in the classroom. The software catalogue included in the teacher training pack *Primary Maths and Micros*, and issued free to LEAs and colleges by the MEP Primary Project, includes many other examples of good mathematics programs which are similarly easy to use.

However, towards the end of my 1983 article there is a conclusion that "there is only a handful of programs which allow young children to undertake mathematical activity at the computer in a truly investigative way." It occurs to me now that this fact really may not matter very much!

We know from the outcomes of small surveys that approximately 40% of primary aged children have a micro at home, although the figure varies from one area to another. The two major activities by 8 to 12 year olds who use micros at home are apparently programming (in BASIC) and playing arcade games. We also know that primary teachers in nearly every LEA (and therefore presumably children in school) are being introduced to the programming language LOGO, usually through the use of a turtle graphics sub-set contained in a program like ARROW or DART. Perhaps all we need to encourage more mathematical investigation with a micro is a machine equipped with a programming language and a collection of ideas as starting points?

Before I go any further I would like to make it clear that I do not wish to enter the BASIC versus LOGO debate that clever computer people argue about. By the time that our primary aged children leave school both of these programming languages will probably have been replaced by something better. What I wish to concentrate on here is the idea that primary children can design and implement a small program which would enable them to do some mathematics. The code or language which they use to implement their solution will be a question of which is the most appropriate – or perhaps, on a more pragmatic front, which they have access to. There could, after all, be advantages if children from an early age appreciate that there is more than one computer language each with its own strengths.

In consequence, the examples which I will use to illustrate what might be possible will not be linked to particular versions of either BASIC or of LOGO. I shall, for example, use long variable names which will assist readability. In all versions of LOGO these are acceptable, and also in BBC BASIC, but the BASIC interpreters in the RML 480Z and Sinclair Spectrum examine only the first two letters of the variable name. The version of LOGO which I shall use does not exist, as far as I am aware, but it is an approximation to most of them. For this idea I am grateful to Peter Goodyear, whose book LOGO: A guide to Learning must be one of the best introductions to the language. Readers who wish to try any of my listed examples on their own machine will therefore need to check the syntax by referring to their particular LOGO or BASIC manuals.

When children carry out mathematical investigations by writing a program for the micro there would appear to be two distinct features. Firstly, in planning and implementing the program and making sure that it works they necessarily go through one of the classic loops in problem solving:

hypothesise	plan
evaluate	test

Secondly, once the program is working it can be used to investigate some mathematics. Questions like "What would happen if we changed . . . ?", or "How many different ways could we . . . ?", or "Would it be possible to . . . ?" can all be asked and explored.

Consider a simple program which will print the quotient of two numbers. In BASIC this could look like:

```
10 REM Find the quotient
20 INPUT "What is the 1st number ";NUMBER1
30 INPUT "What is the 2nd number ";NUMBER2
40 PRINT "Quotient is ";NUMBER1 / NUMBER2
RUN
```

An equivalent program in LOGO would be contained in a simple procedure:

```
TO QUOTIENT
    PRINT [What is your 1st number?]
    MAKE "NUMBER1 READ
    PRINT [What is your 2nd number?]
    MAKE "NUMBER2 READ
    PRINT [Quotient is]
    PRINT :NUMBER1 / :NUMBER2
END
QUOTIENT
```

Once this program is working to the satisfaction of the children it can be used to explore some problems. Eight or nine year old children working on short multiplication and division could try the first two questions. Older juniors and lower secondary pupils could try the more challenging investigations.

Run the program several times. Use 72 as the first number each time, but vary the second number. Try and discover all the possible second numbers which divide 72 exactly. These are called factors of 72. Now use your program to find all the possible factors of 120.

Try typing in some large numbers as the first number. Use 9 as the second number each time. Make a list of those large whole numbers which divide exactly by 9. These are called multiples of 9. Do you notice anything about their digits?

Find a pair of whole numbers which give a quotient of 1.18181818. Find another pair, and another. Which is the smallest pair? Find a pair of numbers each less than 1 which give the same quotient. Do you notice anything about these pairs of numbers?

Use 3 as the first number each time. Try in turn 1,2,3,4,5,6,7, . . . as the second number. What is happening to the quotient? Try some very big numbers as the second number. Make each one bigger than the last. What happens?

Alter your program so that the first number will always be 3, so that you do not have to type it in each time. Try in turn 6,5,4,3,2,1 as the second number. What happens? Try making the second number smaller and smaller. What happens if you make the second number zero? Why?

Modify your program and use it to check the following statements:

$n^3 - n$ is always a multiple of 3
$n^5 - n$ is always a multiple of 5
$n^7 - n$ is always a multiple of 7

Can you draw any general conclusions?

My second suggestion for a program involves finding the area and perimeter of a rectangle, a typical exercise for third and fourth year junior children.

```
10 REM Area and perimeter of rectangle
20 INPUT "What is the length ";LENGTH
30 INPUT "What is the width ";WIDTH
40 PRINT "Area is ";LENGTH * WIDTH
50 PRINT "Perimeter is ";(LENGTH + WIDTH) * 2
RUN
```

The equivalent program in LOGO could be contained in a procedure which has two inputs:

```
TO RECTANGLE (LENGTH WIDTH)
    MAKE "AREA :LENGTH * :WIDTH
    MAKE "PERIMETER (:LENGTH + :WIDTH) * 2
    PRINT [The area is]
    PRINT :AREA
```

```
        PRINT [The perimeter is]
        PRINT :PERIMETER
    END
    RECTANGLE 4 7
```

It seems to me that in itself the writing, testing and de-bugging of such a program is far more profitable than completing traditional exercises on areas of rectangles. But once written the program also provides a tool with which to explore area and perimeter problems, and modifications of the program to explore volume and surface area relationships are not difficult.

If a gardener has 48 fencing panels each one metre long, what is the largest rectangular area which he can fence in? What is the largest rectangular area if he has 80 panels?

If some children need to have 324 square metres of playground, what is the cheapest way of fencing the edges? What if the children need 625 square metres of playground?

If I have a rectangular cardboard box whose top area is 120 square centimetres, side area is 96 square centimetres, and end area is 80 square centimetres, what are the exact dimensions of the box?

In a different example junior children who have been working with the ITMA program JANEPLUS might develop their own short program to simulate a function machine.

```
10 REM Guess the rule
20 FOR COUNTER = 1 TO 10
30      INPUT "What is your number";NUMBER
40      ANSWER = NUMBER + 4
50      PRINT "My number is ";ANSWER
60 NEXT COUNTER
RUN
```

or, in a LOGO procedure,

```
TO GUESS.MY.RULE
    REPEAT 10
        PRINT [What is your number?]
        MAKE "NUMBER READ
        MAKE "ANSWER :NUMBER + 4
        PRINT [My number is]
        PRINT :ANSWER
    AGAIN
END
GUESS.MY.RULE
```

Programs like these are very easy to adapt. Lower juniors, working on multiplication tables, can MAKE "ANSWER :NUMBER * 9, or change line 40 in the BASIC program. They can then try entering in turn 1, 2, 3, ... in response to the question "What is your number?" in order to develop the nine times table. They can make another line change, build perhaps the nineteen times table, and look for patterns in the sequences of numbers generated. They can change the rule again and try their program out on some friends to see how quickly another group can spot what is happening. Older juniors can experiment with both positive and negative inputs, with decimal fractions as well as whole numbers.

Another form of number pattern which can be investigated through writing a program is that of a sequence in which the relationship between one number and the next in the chain is always connected by the same rule. If the rule is "add 7" and we start with 1, the sequence will be 1, 8, 15, 22, ... If the rule is "add the two preceding numbers" and we start with 1 and 3 we generate the sequence 1, 3, 4, 7, 11, 18, ... In both cases, numbers in the chain get bigger and the sequence gets longer and longer. It is relatively easy to develop a program which will print successive numbers in the "add 7" kind of sequence, and top juniors should be able to modify their program to print the "add the two preceding numbers" sequence as well.

But some rules develop different kinds of chains. For example, the rule "if a number is even then divide by two, but if it's odd then multiply by three and subtract 1" produces interesting results. Starting with 5 we then get 14, 7, 20, 10 and back to 5 again. On the other hand, starting with 6 we get 3, 8, 4, 2, 1 which in effect brings the chain to an end. What would other starting numbers produce? Do the numbers which circle back to themselves have anything in common?

```
10 REM Number chains
20 INPUT "Starting number ";NUMBER
30 START = NUMBER
30 REPEAT
40      IF NUMBER MOD 2 = 0 THEN
        NUMBER = NUMBER / 2 ELSE
        NUMBER = 3 * NUMBER - 1
50 PRINT NUMBER
60 UNTIL NUMBER = START OR NUMBER =
1
RUN
```

In LOGO, the procedure might look something like this.

```
TO CHAIN (NUMBER)
    MAKE "START :NUMBER
    REPEAT
        IF REMAINDER :NUMBER 2 = 0
          THEN MAKE "NUMBER :NUMBER
          / 2
          ELSE MAKE "NUMBER 3 * :NUMBER - 1
        PRINT :NUMBER
        IF (:NUMBER = 1) OR (:NUMBER =
        :START) THEN STOP AGAIN
END
CHAIN 17
```

Once again, in either the BASIC or the LOGO program the IF .. THEN .. ELSE line can easily be modified by older primary or lower secondary pupils so that other rules can be investigated. It could be useful to add a further condition for ending the sequence if the numbers get too big. The number of steps in the chain or ring could also be counted by setting another variable called COUNTER to zero at the start, adding 1 to it each time a calculation is carried out, and printing its value at the end.

The examples of programs which I have used as illustrations have all been concerned with number, rather than with shape, position and direction. I have done this for two reasons. One is that the profitable investigation by primary aged children of repeating patterns, spirals, stars and other closed polygons, usually by programming a floor or screen turtle using ARROW or DART, has been written about on frequent occasions. The other is that an important part of the primary school mathematics curriculum is concerned with numbers and the relationships between them.

Of course, many of these numerical investigations could be carried out with an electronic calculator without tying up the computer. But young children (and their teachers too) seem to feel more comfortable with the large screen and the full sized keyboard, and in any case the first and important part of the activity – writing and de-bugging the program – would then be lost. What is quite certain is that the use of the micro in primary mathematics for work of this kind is far superior to the use of teacher prepared programs which ask repetitive questions like "What is 68 divided by 4?" or "Find the average of 7, 8 and 11" and reward correct answers with Land of Hope and Glory. If teachers continue to spend their time creating programs of that kind I would argue that it is they who are experiencing the opportunity to do some mathematics, and not the children for whom the program is supposedly being prepared!

Book list

Primary teachers looking for other simple numerical investigations which children could undertake by programming could try some of the ideas in the following books:

I'm a Number Game. Seymour (1978). Creative Publications. £2-90.

Problem Solving Workcards. Jim Seth (1983). Association of Teachers of Mathematics. £1-50.

Explore Maths with your Micro. David Johnson (1983). Heinemann. £3-50.

Mathematical Problem Solving with a Micro. Snover and Spikel (1982). Prentice Hall. £8-05.

The first of these four books simply presents number problems which can be solved systematically. The other three suggest problems and illustrate some solutions with programs written in BASIC. Readers might find it an interesting exercise to consider solutions to the same problems, but written in LOGO. Beginners with LOGO will find the following book very helpful:

LOGO: A Guide to Learning. Peter Goodyear (1984). Heinemann. £6-50.

Visual Arithmetic:

"The Estimation" and "Merlin" Programs by C.W. Bailey

(co-author of the programs)

Children are often encouraged to handle numbers as symbols before they really understand what the symbols are meant to represent. The Estimation Programs are designed to "make numbers make sense" by mapping them into different contexts using the graphical potential of the computer.

There are 6 programs in the series:

1. Butterflies .... items
2. Putting.................................. length
3. Time-Flies................................ time
4. Tanker.................................... angle
5. Tiles .... area
6. Fence .... perimeter

They are designed for the primary school range.

Children need to develop a general idea of the relative size of numbers, to get a 'global feel' for number. However the symbols themselves are asbtractions and do not represent their relative magnitudes visually. 27 and 72 for example take up just as much room on the page. The computer can show the relative sizes of numbers, represented visually, and allow children to build up confidence in manipulating numbers because they can see what is happening.

The value of estimation

The Cockcroft Report stresses the value of estimation. Having a rough but reasonable idea of a quantity helps to make common sense available to problem solving. In each game the child is encouraged to make a guess and to see how his/her guess compares with the actual quantity represented. However, the programs go beyond the initial estimation process, because the child is allowed to refine the estimate by successive approximation, or arithmetic, to arrive at a correct answer. The programs set problems to be solved but do not dictate a method of solution. They are designed to be easy to run and to have flexibility. The level at which the child plays the game can be set by the teacher. The child than has a choice of an easy or harder option.

A lot of software cuts children off from the problem after two or three goes, or has a built in time limit. These programs have neither. They wait until the child is ready to put in an estimate, and allow as many tries as are necessary to solve the problem. As a consequence they can be used successfully with slow learners, as well as with younger children.

All the programs set problems at random (within limits controllable by the teacher), but each has a two-player game which allows user control over the numbers generated.

Because our number system is based on ten, then any number can be represented by repeated use of a set of ten symbols. The use of place value makes the system particularly powerful. The problem is that this sophistication is not obvious to young children. In many infant classrooms there is a number line or number chart. This usually shows pictures of items to represent the numerals up to ten. (Occasionally up to 20.) Once children have begun to grasp the relationship between the first few symbols and their concrete representations they are often expected to operate in the stratosphere of symbols. Educationalists have stressed again and again the value of practical work and/or structural apparatus, so that the child's understanding is based on actions and the consequences of them. The computer is not meant to replace this meaningful practical activity, but it can extend it, and perhaps replace some of the less meaningful activities that can take place in exercise books.

For some years now early work in number has tended to emphasise the cardinal aspect of number. Children have been encouraged to classify items into sets and establish their comparability by processes of matching. The theoretical underpinnings of this approach lie with Russell and Piaget. However, more recent work in educational psychology would indicate an increased emphasis on the ordinal aspects of number. Counting is a serial process, and in this operation the ordinal aspect is prominent. A bigger number comes later in the series, it takes longer to get to it. The Estimation programs deliberately include this aspect. In Butterflies, for example, the items do not appear simultaneously but successively. Their appearance is accompanied by an ascending series of tones, so that bigger numbers take longer to appear and reach higher tones. When overestimates are corrected then the tones descend, and items are removed successively from the screen. In Tanker the submarine rotates through all the intervening angles to arrive at the player's initial estimate. In Fence the pieces again appear successively accompanied by tones.

The graphical potential of the computer

A general principle throughout is the constant interplay between concrete visual quantities and their representation as symbols. The intention is to give children a 'feel' for numbers by interacting with them.

A lot of software exists which presents children with arithmetic problems, as they would have been seen in the elementary arithmetic books of the nineteenth century. The graphical potential of the computer is used as an EXTRINSIC reward for the solution of a problem presented purely in symbols. If the child doesn't know what 15 + 9 is, then there is no way of discovering the solution from the graphics. What is more the operation of addition is given. In the Estimation Programs the child has to decide which operation (+ or –) is appropriate and the graphics are INTRINSIC to the process.

The programs are easy to use and children can get on on their own without having to be constantly supervised. However, observing how a child works on the problems can be a very useful diagnostic aid.

Is the program effective?

In the course of a child development diploma study, Dilys Skan undertook to find out whether using the program "Tanker" had any effect on children's angle estimating skills.

The scenario for the problem is as follows:

An oil tanker is leaking oil into the sea and causing pollution. Marine life, represented by a whale, is threatened. A submarine is called up to sink the tanker and to burn up the oil slick. In order to emphasise that the torpedo serves a benign purpose, the crew is visibly rescued and it is made quite clear that it is a deserted environmental hazard which is being removed.

The tanker appears at a randomly determined position around the 360 degrees and the child is asked to estimate its bearing from North. Once this estimate is entered, the submarine rotates to that bearing and looses off a torpedo. The discrepancy between one's guess and the tanker's position is obvious. After successfully adjusting the angle a cross in the tanker's engine-room is hit, the ship disappears and the oil burns up. The whale then expresses its approval. (There are options available to change the range of angles operated in, and the step size can be adjusted.)

Two groups of children, eight year olds and ten year olds were used. They were subdivided into an "experimental" group and a control group. All the children were given a paper and pencil test first. This consisted of two equivalent forms, A and B. Half of each group did the A form and half the B. These were reversed at the end to form a post test. The test was a page of drawn angles, at various orientations. The child was expected to study the angle, to make a guess as to its size in degrees and to write this on the paper. If the child was correct a score of 5 was given, 4 was awarded for a guess which was within 5 degrees, 3 for within 10 degrees, 2 for within 15 degrees, 1 for within 20 degrees, and 0 for any guesses which were outside of this range. This meant that each child had a total score for the 20 angles which were in the test. The experimental group then played "Tanker" individually for 20 minutes. The control group did not. The scope of the study did not allow for the testing of anything but short term gains. After the "Tanker" session was over each child in the E group was given the other version of the paper and pencil test, and again asked to write down their estimates of the angles presented. The control group also completed the other form as a post test.

The scores for the control group were not significantly different between the two testings. If the game was great fun but ineffective, we would expect the same result for the experimental group. However, the experimental groups in both the age ranges showed highly significant gains in their angle estimation scores on the post test. So even as short a time as twenty minutes, without the benefits of discussion with a partner, produced changes in the children's ability to estimate angles. This doesn't mean, of course, that a further control group taught by more conventional methods wouldn't also have improved, but the software runs itself, there is no marking, it maintains attention, and the children seemed to find it fun.

I have used this program myself, with children who had done no previous work on angles, as a precursor to playing "Treasure Islands" (Cf Spanish Main in Microprimer). My impression was that the previous experience with Tanker helped to make the first run through of the simulation much smoother, and this meant that they got into the strategic thinking earlier.

Children seem to find it fairly easy to map numbers on to items. Their knowledge of counting can be applied directly. In mapping numbers onto distance the child needs to appreciate that a length can be subdivided into units of equal size. These units can then be treated as items and the counting system applied. However angles are more difficult to understand. The fact that numbers can be imposed on "amount of turn" is not at all obvious. Static drawings of angles on paper would seem to hide the idea of amount of turn. The dynamic nature of the rotation of the submarine, plus the fact that the tanker's distance from it varies, provide a scenario which is reflecting this property of angle very clearly. One dares to wonder whether playing tanker before using Logo and the turtle might speed up progress in the early stages!

Multiplication tables programs

We have used the same principles of making numerical quantities directly visible in a further series of programs directed towards the multiplication tables. The Series is called "Merlin Teaches Tables" and consists of four programs:

1. Merlin's Magic Tables
2. Merlin's Magic Ducks
3. Merlin's Magic Skittles
4. Merlin's Magic Calculator

There are plenty of programs aimed at TESTING children on their tables. These programs are designed to provide some conceptual under-pinnings. The first one provides displays of the table problems so that for example 5 × 5 is not an abstract problem, but a graphical display of twenty five items arranged in rows of five. Again the "have as many goes as you like" approach is used. If the child were to put in 55 as the answer, then the display shows 55 items and the child can SEE that this is too big and try again. In this way children are led to discover the answers to the tables problems, and can be encouraged to use 'counting on' strategies or any techniques they find appropriate.

The second program "Merlin's Magic Ducks" sets up a display of 'n' ducks. The problem is to find the factors of 'n'. A number is entered and the ducks change their orientation in sets until no more can be changed. If the number is a factor then the last duck will have turned round. It then lays an egg which is collected on a number line. If the number entered is not a factor, then the last duck remains unchanged.

Merlin's Magic Skittles again has the quantities we are dealing with as visible items. In this case skittles. It is designed to be a fast action game to prove to yourself that you know your tables.

Merlin's Magic Calculator is not a game but a tool. You can do arithmetic on it and watch the items being rearranged. It allows all four functions +, –, x, and ÷.

My experience of using these programs in school has confirmed my hunch that children can make more sense of numbers when they can see what they represent, but it has also confirmed my pre-computer experience with mathematics in primary school. There is no magic short cut to numerical understanding. Children need a mathematically rich environment and problems which are real to them. The computer has a variety of parts to play in enhancing this environment.

We have put a lot of work into the documentation of these programs, not merely to help teachers and parents get the most from the software, but to indicate a variety of related activities away from the computer which should further understanding. One of the computer's strengths is its interactive graphical potential. Numbers are essentially abstract. If we can use the graphics to make them less abstract in the early stages, this can go alongside the practical activities to give the final written arithmetic more meaning.

References:

Bill Bailey and Brian Lienard (1984) "*The Estimation Series*" University of London Institute of Education/ Hodder and Stoughton

Bill Bailey and Brian Lienard (1984) "*Merlin Teaches Tables*" Hodder and Stoughton

Skan, D. (1983) "*Microcomputers in Primary Education: An Evaluation of Some New Software*" Special Study for the Diploma in Child Development. University of London Institute of Education.

NB Details of the programs mentioned in this article can be obtained from Hodder and Stoughton Ltd, PO Box 702, Mill Road, Dunton Green, Sevenoaks, Kent TN13 2YD.

Computers and the Teaching of English: A Flight of Fancy? by Phil Moore

Some would have you believe that the computer is a panacea, the best thing since sliced bread and the greatest development in education since Gutenburg. It is not. It does have the potential to become one of these things, the latter, but only insofar as good teaching makes it so and that, really, is the crux of the matter. Already there are teachers around this country who have become disillusioned with the computer and who will probably never use it again, partly because they were ill-prepared for its use and partly because their expectations had been raised by the aggressive marketing employed by some computer and software companies. In English, the early programs provided little of educational value, demanding passive key-pressers as users and being little more than time-fillers and a genuflection to the cult which was rapidly growing about the computer in education. The times, as the song goes, are a'changin', however, and the computer is beginning to be used as it should be used, in English especially, as a liberator of the imagination.

One sign that this is the case is in the development of software appropriate to the needs of teachers and their pupils. There are a number of areas which are beginning to be explored, including adventure games. These programs, derived from the Dungeons and Dragons role-playing game from America, involve the user negotiating his way around a number of problems in order to retrieve treasure and, thus, score points. Recently, however, a number of programs have widened this approach and games such as GRANNY'S GARDEN involve an interesting plot and an alternative to the vicious and death-dealing monsters of old. In this program, a wicked witch has kidnapped six royal children and hidden them in various places, and the user must find them, negotiating traps and solving riddles in order to do so. The problem-solving skills, logical thinking and common sense required to reach the end of the program can provide an excellent learning opportunity. Simulations, programs which demand a more formalised role-playing situation, can be equally useful in the English classroom. Two particular programs stand out for the slightly older child – MARY ROSE and SAQQARA, both based around the excavation of significant historical sites and involving teams of children systematically searching for relics.

Apart from these two types of program, which have been around for a relatively long time, there are new areas being developed. ABC is a superb basic word-processor, designed for the younger pupil and possessing some very interesting features but, above all, much simpler to operate than the average word-processing program. TALKBACK enables the user to 'create' characters which can conduct a conversation, with the user either 'listening in' or joining in: in the latter case, the characters appear to respond to the user. ADDVERSE is a program which allows the animation of text, so that poems come to life, with words appearing on the screen in rhythm, moving about and changing colour as the sense, or user's interpretation, suggests. The various versions of TRAY present the user with a text totally deleted, leaving either dashes or spaces for letters, leading to a language-stretching exercise for pupils, with the added advantage that it is easy for teachers or pupils to use their own text for decoding.

I offer these examples not as detailed reviews, but rather to demonstrate that it is becoming increasingly difficult to bemoan the fact that there are few programs of any value. Nevertheless, all of the above-mentioned programs are worth using in the classroom, most of them for pupils from the age of six or seven upwards. They are only worth using in the classroom, however, if they are used imaginatively. It would be simple, in some cases, for the teacher to merely load the program and sit back, letting the computer do the work, but all of the programs were designed to make the pupils do the work, the reason why I recommend them. In order for this to happen, much has to be done away from the computer within a carefully-structured framework and, hopefully, within an overall plan of work of which the computer programs form a natural part – to do otherwise would give an undue importance to the computer.

After all, why use the computer in English at all? It is true, of course, that computers will play a far more important part in our pupils' lives than it has in ours so far and it must be part of the teacher's task to help to prepare pupils for this. Powerful computers are already within some pupils' purchasing power and are, relatively, becoming cheaper all the time – it will not be long before they are as common in the home, and in the business world, as televisions are now. It is not yet a widely recognised fact, however, that any contact with a computer is primarily a linguistic experience, and that places the computer, perhaps more than anywhere else, right at the heart of what we call English. In simple terms, the computer communicates with the user either in words, pictures or sounds, through the monitor screen, via the printer or with devices such as the Turtle, and only very rarely will the user not have to make sense aurally or visually of the computer's output, either by watching, reading or listening. If one concedes that in Language Development we are attempting to refine the pupils' abilities in these, and other, directions, then the computer must have a place. This means, of course, that any use of the computer in schools will provide language work to some degree, but its use in English should be to exploit the linguistic nature of the computer environment to the full, rather than in any peripheral way. To use programs in a disjointed, piecemeal manner focuses attention on the computer rather than the language experience, and that is neither desirable nor useful in the context. Therefore, computer programs, such as the ones mentioned above, can provide learning opportunities in Language Development as long as they form a natural part of a sequence of work.

A number of Primary teachers have conceded the above points to me yet still ask why they should use the computer in English rather than other 'tried and tested' methods. The answer lies partly in the fact that it is possible to see the computer replacing other media, and there may well come a time when pens, paper, books and the other traditional accoutrements of English are rarities as computer-related technology enables us to speak rather than write and hear rather than read. Another answer lies in the computer's facility to offer excitingly new possibilities for the English teacher. Consider the programs which I have mentioned: how many pupils have creative abilities frustrated by their bad handwriting and are reluctant to commit themselves to paper when the presentation will interfere with the ideas. A word-processor such as ABC will, at the least, give those pupils confidence to start expressing themselves in writing. How many pupils are unaware of the dynamic nature of words? A program like ADDVERSE will help them to see that words are alive and vibrant. How many pupils have had the satisfaction of creating a character which speaks independently of its creator in an apparently intelligent manner? A program like TALKBACK will give pupils that satisfaction, as well as helping to teach the concept of character, amongst other things.

Yet another answer lies in the effects of the computer on a classroom. I have heard many people claim that they can do little with one computer and thirty-plus pupils in a class, yet I believe that this could be a positive bonus, because the only practical solution is small group work. When working together in this way, pupils learn about the transactional nature of talk, discussing mundane matters such as who is going to type and what is going to be typed. Decisions made are group decisions, involving a very complex use of language, and the solving of problems becomes a group learning activity rather than an exclusively solitary pursuit. Of course, only one group at a time can use the computer, so the teacher needs to devise related work for the other groups which reinforces the need for the inclusion of computer programs in a scheme of work. Take GRANNY'S GARDEN, for example: each group would take it in turns to work on the computer, and the other groups could be writing stories about their exploits, creating new problems, writing new spells, doing research into witches and witchcraft and writing a book of 'hints' for new users – all activities which arise from the program, but which have value in themselves. Programs such as MARY ROSE and SAQQARA are helpful in that they suggest some, but not all, of the possible related activities. When used in this way, computers can help individual groups to keep 'on task' and free the teacher from some of the management problems, whilst, at the same time, introducing new learning opportunities.

All of this is a long way from the idea of pupils as passive screen-watchers and button-pushers and from the idea of the computer as an end in itself. With the programs which I have mentioned, and others, we now have the chance to use computers effectively in English, a subject area in which engaging the pupils' imaginations is an important element. Imaginatively used within a structured framework, the computer can, indeed, take our pupils on a flight of fancy.

PROGRAMS

ABC

TALKBACK

available soon for the BBC Micro from
Acornsoft, c/o Vector Marketing Ltd., London Road, Wellingborough, NN8 2RL

GRANNY'S GARDEN

available for the BBC, Spectrum and (shortly) RML 480Z

from
4Mation Educational Resources, Linden Lea, Rock Park, Barnstaple EX32 9AQ

ADDVERSE
available for the BBC from CLASS, 93, Bedwardine Road, London SE19 3AY

MARY ROSE
SAQQARA
available for the BBC and (shortly) RML 480Z from Ginn & Co., Prebendal House, Parson's Fee, Aylesbury HP20 2QZ

TRAY
available from various sources – an ILEA version is obtainable under licence: speak to your English/ Computing Advisor. Alternatively, a version for the BBC, called CLASS READER 1, is available from CLASS.

RECOMMENDED READING

Adams, A. & Jones, E. 'Teaching Humanities in the Microelectronic Age' Open University Press, 1983 ISBN 0 335 10196 8

Chandler, D. (ed.) *'Exploring English with Microcomputers'* Council for Educational Technology 1983 ISBN 0 86184 102 6

Chandler, D. *'Young Learners and the Microcomputer'* Open University Press 1984 ISBN 0 335 10578 5

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"PODD" by Di Wailing

IT Centre, Davidson Centre, Croydon

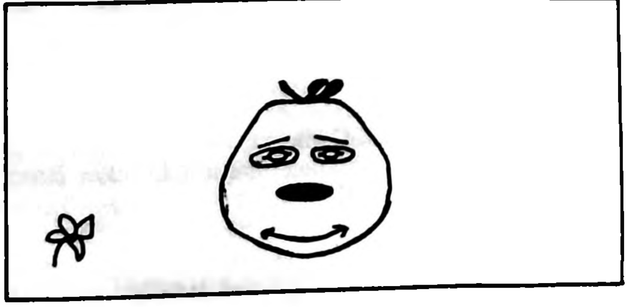
Simple is best, could well be the most reliable maxim to adopt when searching for good software on a limited budget.

Many infant schools coming to grips with a micro for the first time are unwilling to spend vast amounts on something which could be a passing craze and might well, in 2 or 3 years time, end up gathering dust in a stock cupboard. They are justifiably wary of the bright cartoon character packaging and equally bright promises. In fact, much of the maths done at infant level and beyond is far better handled practically with paper, scissors and string allowing for experimentation, and investigation on the part of the child, who is gaining valuable skills in manipulation and estimation. Much infant software falls into the drill and practice format or the board game transferred on to the screen for a limited number of players.

So it is not necessarily towards the discipline of mathematics we should be looking for the great contribution of the micro to our classrooms, but maybe as another and unique tool in the field of language development.

Of course, introducing the micro at all into infant classrooms invites a barrage of doubtful faces and anxious questions about upper case Qwerty keyboards. Rarely does an infant program allow for a dimension of real creativity, playful thinking and a potential for development both forward and laterally. This is where Podd scores so overwhelmingly. It's simple to use and it generates an immediate response', can be used initially with the whole class, but also developed in groups. And because as such the program has no beginning, middle or end, it can be terminated whenever the class, or more likely the teacher, has had enough, just be pressing BREAK and announcing in portentious tones "There – see what's happened, you have made so much noise you've given PODD a headache and he's gone home to lie down!"

Podd can



PODD offers 2 options.

OPTION 1
Podd is a bright, cheerful-looking character, who appears on the screen under the intriguing caption 'Podd can.........'. This title automatically invites comment and the children aren't slow at coming forward. Suggestions rain in – jump, run, talk, walk, etc.

At first, depending on the age of the children, the teacher may wish to type in the words, but soon the children, entranced by Podd's antics on the screen, begin inching forward to take over the keyboard themselves. Of course, correct spelling is crucial, but when working in groups or with the whole class, there is always one child or more who will point out or correct wrong spelling. Fun is a great (and underrated) impetus to learning. Children, even very young ones, soon learn the magical formula (correct spelling) which triggers Podd off on their favourite action. They are inquisitive too and soon want to discover how many more, (there are 123 in all) Podd can perform. They soon discover he can't work with objects; for example he can't 'ride' because he'd need a bike or something else to ride on.

Children enjoy collecting, on wall charts or in books, not just the things Podd can do, but also those he can't and this has led to some rather interesting discussions. For instance, I never say what I think Podd is, even whether he's male or female, but I let the children create a character for themselves. One group decided he might be some kind of fruit and made a block graph of their own opinions, listing Podd as everything from a strawberry to a pumpkin. Another group of top infants tried the more sophisticated technique of elimination. They reasoned that every creature makes a noise so they tried making Podd quack, then bark, then croak, all of which got the reply "Oh no I can't." It took some while before they got round to talk. They also assumed he couldn't run, because he hadn't got any legs. One member of the group insisted they test their theory by typing in RUN. They were a little taken aback to see Podd had suddenly sprouted legs from nowhere. These arms and legs mysteriously disappeared again at the end of the sequence. Why then, they reasoned, couldn't Podd himself simply vanish? So they typed in VANISH and were delighted with the results.

When used in this way, Podd is allowing the children an opportunity for playful thinking. There are no penalties for mistakes. The children are testing hypotheses in a completely free and unrestricted way, simply allowing their imaginations free range. It also produced some intriguing reasoning. One group, after having typed in SWIM several times, asked the teacher to check their spelling in case something was wrong. They felt convinced that since he could FLY he ought to be able to SWIM. This led them to speculate that maybe nobody had taught him to swim and that this was serious as everybody should learn to swim. Supposing PODD crash landed in the sea? The conversation then turned on how to teach Podd to swim. Someone suggested that as Podd was round maybe he could FLOAT. Surely all round things can float? Back came the message "Oh no he can't". This led to some very interesting and impromptu science work in the water tray.

As to actually introducing Podd into the classroom there are one or two strategies you might wish to adopt. Initially, it makes a good class activity. It's amusing, it engages the attention and the imagination and all the children can be introduced to the program at the same time. Also, as I have already mentioned, it can be stopped at will.

Beforehand, the teacher may prepare about 10 pieces of plain white card like extra large flashcards. As the children discover a new action, it can be written on the card and then at the end of the session those actions have been 'saved' so the children can use them again as references to type in actions. These flashcards can be added to after each session, or even better, children can make their own picture dictionary of PODD's actions on the wall or in a book. The ones he can't do should also be included as well.

They are not wrong answers, just actions Podd can't perform. To treat them as wrong answers would be harmful, as it might inhibit the children's enthusiasm for searching out new words to test on the program.

The discovered words need to be displayed around the classroom so that discussion can be generated and connections between some of the words can be made. Many of the words are synonyms, and once TALK has been discovered other children might want to suggest speak, chatter, mutter, whisper or even drone.

Thinking of the younger children in the reception class, slightly different tactics can be adopted to introduce Podd as a discussion tool. If the teacher blanks out, with a piece of paper, the top half of the screen, so the children cannot see the words 'Podd can ....' and then types in a word like SNIFF or DANCE, she can then ask the class to guess what they think Podd might be up to. Each 'guess' needs to be typed in on the now uncovered screen and the children can watch and see whether Podd is repeating his original action or not.

Apart from discussion and experimentation in the classroom, links can be made with other activities such as Art or PE. Podd is such a simple shape to copy or paint and appeals naturally to the children. One teacher made Podd masks with her class so they could act out little dramas of their own. An interesting development she noted was that when in PE she tried using Podd's actions as a basis for movement, the children's enthusiasm got the better of them. However, once they were wearing their Podd mask and under the impression they were now anonymous, they became far more relaxed, manageable and creative. They reinvented games like "Podd can", based on 'Simon says', so if the teacher said 'Podd can swim' and some children mimed swimming they were out, because Podd can't swim.

Podd was also integrated into the class's project on Light. If it was daytime their actions in PE were at normal speed but if they closed the curtains to make it night, Podd's dream actions were in slow motion. From masks, the idea of puppets was developed, simple hand puppets around which simple stories could be created. One class are even now busy creating Super Podd in papier mache, using a large balloon for the base.

From their investigations, it soon also become quite clear that Podd could do nothing wrong. He couldn't kick or fight or swear, a fact which one enterprising teacher used to advantage. Having discovered 2 of her class scrapping in the playground, she escorted them back to the classroom. Having lectured them on the error of their ways she finally drove home her point by typing in 'Podd can fight' Podd's immediate reaction was 'Oh no I can't!'

Who's going to argue with that!

OPTION 2

After a reasonable period of investigation and word gathering the children are now ready to be introduced to Podd's second and perhaps more powerful option. This allows up to 5 of Podd's actions to be joined together in a continuous string. For example you could type in

SNIFF
RUN
EAT

and Podd will perform these 3 actions one after another.

This now opens a truely creative side of the program for the children to experiment with. While Podd is cavorting on the screen, they can be narrating a simple little story illustrating the reasons for his actions.

Sample Story 1.
SNIFF
RUN
EAT

The top of the screen with words "Podd can ......" needs to be covered with a piece of paper so the children cannot see which action is coming next

NARRATOR

"Podd was out one day walking when he smelt the most delicious smell and it reminded him he was hungry and he wanted his dinner. So he began to run as fast as he could back home, but it was a long way and he began to pant. When he got home he sat down and gobbled up his dinner as quickly as he could, making a lot of noise because his table manners weren't very good."

The children take any 2,3,4, or 5 of Podd's actions and arrange them into a sequence and collaboratively create a story around them. When they've finished the story, it can then be retold, by one or more members of the group, to the rest of the class, while Podd goes through his paces on the screen.

The children now have power over the micro; Podd is being programmed by them and moving to their commands.

The full potential of the program now begins to unfold. It encourages children to become storytellers. Though not all of them can write fluently, they can talk, discuss and juggle ideas verbally. Their imaginations are only limited by the actions Podd can enact, and if the top of the screen is covered, they can find the nearest known action to fit in with their story line. This gives full rein to their spoken language and children who are inhibited by their knowledge of spelling or manual dexterity now exhibit a command of vocabulary hitherto unsuspected by the teacher.

Stories are a very natural medium for children to work in. The books they read are composed of stories, teachers and parents read them stories and they are constantly being required to write stories of their own. Now, however, another important facet of language development is introduced – that of audience. Stories are created with other people in mind. This means that time and care, or if you like verbal editing, take place, refining and polishing their words and ideas with each other to design their own story.

Children, for the most part, are competent conversationalists by the age of five and well able to understand the language used by teachers. Not only does this give them a chance to show their verbal expertise but also develop specific skills, like adlibbing for instance, when Podd takes longer than expected to perform a particular action. However, the role of narrator or narrators has been traditionally fraught for the capable but shy. Now with the attention of the audience firmly fixed on the screen, and Podd's antics, the storytellers can step out of the limelight to the side of the group, behind the micro or even behind the audience.

Eventually, of course, as children's needs, competences skills and imaginations grow, they will become dissatisfied with the limitations of the program and want and need to move beyond what Podd can offer. It is right that they should; perhaps on to storywriting of their own, maybe wordprocessing or even a halfway house like the program 'STORY'. What Podd may have given them is the impetus to collaborate with and learn from others, or the incentive to improve, refine and expand their own stories, or the thrill of enrapturing an audience and the satisfaction of having entertained their peers. Or simply, because talking is such a natural medium to all children, it has given them the chance to succeed at something where they have every chance of success.

Homes: Topic work using a computer in a village school by Sue Stowe

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This article relates some of the experiences of a class of Junior children in using a computer as part of their topic work, looking at homes and housing development in their village.

The school and the area

The school (New York County Primary) is a small school in rural Lincolnshire. The area is very flat and intensively farmed and although only nine miles from Boston (a busy market town and port) the children live in isolated homes spread over a five mile area. Many of the children only meet their friends in school and have very limited experiences, few have travelled much beyond the immediate area.

The school was built in the 1880s and is in the centre of the parish of Wildmore. It is a typical brick-built, slate roofed building and is surrounded by fields. The road in front of the school is extremely straight ('the seven mile straight') and busy with fast moving heavy traffic.

Although externally the building is still Victorian, inside it reflects the 1980s with lowered ceilings, efficient central heating, carpeted floors and modern furniture.

The pupils come from a range of backgrounds, their parents may be tenant farmers born in the village, some are from families rehoused into the three rows of council houses, and some from families who move into the area to take advantage of the cheap housing. There is an active School Association and the parents have provided many of the books and materials in school.

The school's junior class has 20 to 25 children aged eight to eleven years covering the whole ability range. The children are taught in small groups or individually for mathematics and language. For most of the topic work the children work on the same topic but at their own level; each child produces his or her own hard-backed book which reflects a particular area of interest in the topic. The topic work is designed to expand the children's awareness and appreciation of the world they live in, and in producing their own books the skills they have learned are put into practice.

Working with another school

The school works closely with another similar school (Carrington County Primary) some five miles away. This co-operative work is based around one morning each week when children from one school travel to the other so that all the junior (or infant) children from both schools can work together. There are many advantages to this co-operative working, in particular it enables the children to work with a larger group of their peers, with a different teacher and in a different environment. Working with another school has also meant that joint outside trips have become viable, and expertise and equpment shared.

Introducing a microcomputer

A computer was first introduced into the school three years ago; recently the work is done on a BBC micro. The system the children use includes a disc drive, a printer, BBC Buggy and Edinburgh Turtle. (This equipment has been either purchased by the School Association, is on loan or is a purchase shared with other schools.) With the relatively small number of children in each class, the computer is normally available whenever it is required and a small group of children can use it undisturbed for long periods of time.

The computer is only used as part of the class work if its use either extends or enhances the work the children are already doing. Except when we were finding out how a

piece of equipment or a program works, we successfully resisted the temptation to make the microcomputer fit into the work or the work fit a program. It is however expected that all the children can, when appropriate, use all the programs and equipment available.

Work on the 'Homes' topic
One recent example which illustrates how we have used the computer as part of our topic work was 'Homes'. This topic continued for most of a term and was one of the joint topics undertaken with the other primary school. Through the topic it was hoped the children would become more aware of their homes, of the methods and materials used in the construction and that they would understand the patterns of local housing development and possible reasons behind these.

The computer was used in a variety of ways to extend the children's work on this topic.

Using a BBC Buggy
The school has many different scale maps of the area (road, Ordnance Survey and Water Board Drainage maps). These maps were used by the children to draw their own scale maps of the area around the school showing their homes. The maps produced were approximately one metre square (to fit on the buggy park, the two old desks covered with hardboard which we have found to be a suitable work area for buggy). The program we used, Snail, requires the user to work out a sequence of moves (direction and measurement) which the buggy will then carry out.

The children worked out the necessary directions to program the buggy to carry out a variety of tasks on their maps.

eg Visit each house in turn (to empty the dustbins)
Visit the Post Office and then named houses (the postman)
Visit named houses (school bus run)

The tasks were set by the teacher, by the children or by one group for another. Using the program meant the children had to think logically and to be able to measure, and use accurately, centimetres and degrees. The computer was only necessary when trying out a solution; most of the work was done by groups observing and then discussing what happened in real life. The postman was quizzed as to how he worked out his route – did he check daily to see if no mail to particular homes meant a change of route was sensible or did he go the same way every day irrespective of deliveries? Different routes were planned and measured and as a result further problems set like 'visit all the homes using the smallest number of right turns at junctions'.

The way the computer was used within the topic helped to develop the children's problem solving skills, encouraged much useful discussion and fostered co-operative working. Obviously there are other ways of approaching similar ground and some other programs are more flexible. For this work the Buggy was used as the children preferred its more compact size.

Using a Turtle
As part of the topic the children drew many pictures of houses – their own and those in the vicinity of both schools. Many of the children became interested in using the program Dart to draw houses. This helped to stimulate work in perspective and encouraged accurate observation.

Creating a data bank
Whenever possible within a topic we have tried to build up a data bank of the information the children find; whenever possible this is data collected by the children as a result of their first-hand experiences. It seemed to us that a data bank of the children's homes could lead to some interesting work. The program used was a commercially available data base system *Vu-File*, which we have found easy to use and flexible.

After much discussion a list of headings was drawn up and it was decided to use the computer and printer to produce a blank record sheet for each child (at both schools). The preparation of this sheet involved a great deal of checking, the children used their knowledge and the library's reference books to ensure that every possible entry under each heading was covered. (Even though many of the entries would not be needed for our data bank the children wanted to ensure all homes in Great

Britain could be included if necessary.) It was interesting to see how it also encouraged the children to observe the houses they passed either on their journey to school, when we visited the other school or when out with their parents. (It was decided that to ensure there could be no invasion of privacy no details of the inside of the houses would be included).

RECORD SHEET: HOMES DATA COLLECTION

Occupier's surname ....

Address ....
(Street and Town only)

Circle the correct entry for the above home

Home type det	/ semi / terr / det bung / flat / mais / other
Exterior walls	brick / wood / concrete / block / stone / other
Main roof	slate / clay / concrete / felt / thatch / other
Window frames	wood / metal / alloy / other
Services	gas / elect / water / all
Drainage	main / septic / cesspit
Telephone	yes / No
Garage	yes / No
Age (main bulding)	A (1961-present) B (1946-1960) C (1901-1945) D (1801-1900) E (pre-1800)

Each child took the record sheet home so that the details could be checked. Several of the parents showed a keen interest in the children's work and we received many items of building materials for our school display. One house was being re-roofed and samples of the old and new materials were sent to school. The sheet also encouraged some parents to find out more detailed information about the history of their homes and this information was also sent along with detailed drawings done by parents and children at home. Using their record sheet each child then typed their own house details into the computer.

Using the data bank

When the data bank included all the children's records it was used in a variety of ways. The children were encouraged to hypothesise and to use the data bank to investigate their theories. Often this encouraged the children to seek further information. Thus we found many of the houses had originally had slate roofs which had been replaced when re-roofing grants became available. Two children (one from each school) found their homes were almost identical because they were both ex-police houses sold off when the village stopped having their own policemen. The children also worked out from the age data a rough growth pattern for the area. This reflected the need for housing after the land was drained in the 19th century and there was an influx of farm workers. More recent building also reflected the necessary provision of council homes and in the last 10 years again new, this time individual, private houses are being built taking advantage of the cheap plots of land. The record sheet also encouraged the children to think about the differences between their homes and homes in towns. A local estate agent provided hundreds of 'for sale' details and these were carefully examined. The children began to appreciate some of the main differences and the reasons for them.

The computer's contribution as a small part of the topic
The work using the computer was only a very small part of the whole topic but its use did extend the children's work and, in particular the data bank encouraged the children to pose questions and to seek answers. Other non-computer work included:

- model making; a clay village (Clayton) was made;
- sewn and collage pictures were produced;
- detailed examination of house construction was undertaken;
- miniature brick walls were built using different bonding patterns;
- book covers were printed;
- many detailed drawings and paintings;
- creative writing including poetry;
- machines in homes were examined and working Lego models made;
- 'dream' homes were planned and detailed drawings made;
- changes in homes throughout the ages were discussed.

Obviously when looking back on a topic and evaluating it for future reference there are always certain improvements that seem obvious in retrospect. The computer played a valuable part in helping the children to develop their work on this particular topic.

Sue Stowe was headteacher of New York County Primary School. She is now headteacher of Keelby County School, South Humberside.

Micros and primary science by Jan Stewart

This article first appeared in MUSE Report No. 5 1984 and is reproduced with permission.

Since the sixties a considerable amount of time and money has been devoted to promoting the teaching of primary science. However, in 1978, a major Inspectorate survey showed it remained one of the most problematic areas of the curriculum.[1] Few teachers were willing or able to teach science and no observational or experimental work occurred in as many as 80% of primary schools. This was the worst track record of any subject on the curriculum. Where science was taught it was often done so inadequately. Insufficient attention was given to ensuring proper coverage of key concepts. Principal content was biological rather than the physical sciences. Children's questions were rarely used as starting points, and encouragement of vital processes such as observation was all too often only superficial.

Clearly, primary teachers find science a difficult subject to teach! If a microcomputer could support them in their task it would help alleviate a major problem. Already micros are well established for use in teaching science in secondary schools. This would offer some cause for optimism, but the question that needs to be answered is how.

Fortunately, there exists agreement on the sort of science that is right for young children. Learning skills of enquiry, fostering attitudes and developing basic concepts are emphasised, rather than building a structure of factual knowledge.

> 'Teach your scholar to observe the phenomena of nature; you will soon rouse his curiosity, but if you would have it grow do not be in too great a hurry to satisfy this curiosity. Put the problems before him and let him solve them himself . . . Let him not be taught science, let him discover it . . .' (Rousseau)[2]

> '. . . the task in school is not one of teaching science to children, but rather of utilizing children's own scientific way of working as a potent educational tool' (Nuffield Junior Science Project)[3]

If microcomputer programs are to aid primary science they must have a central aim consistent with that of the Schools' Council Science 5/13 Project, namely 'developing an enquiring mind and a scientific approach to problems'. More specifically this means:

1. developing interests, attitudes and aesthetic awareness;
2. observing, exploring and ordering observations;
3. developing basic concepts and logical thinking;
4. posing questions and devising experiments or investigations to answer them;

5/6. acquiring knowledge and learning skills;

7. communicating;
8. appreciating patterns and relationships;
9. interpreting findings critically.

Is this possible on a micro? A look at the potential of software already available and a glimpse at the future might help.

SCIENCE-SUPPORTING PROGRAMS

Science-topic programs

The purpose of programs in this category is to support, in a useful way, or add interest to projects. For example, several programs exist on astronomy. In primary schools, astronomy typifies the inevitable difficulties of following up ideas with observation. Most young children are in bed by the time constellations are visible and the 'capital effect' masks observations in many urban areas. Confining study to winter months is one solution and access to a planetarium eases the problem. However, even where the latter is available, it is not generally possible for a class to have the regular use necessary for serious study.

One solution is to bring the facilities of the three-dimensional planetarium on to the two-dimensional screen of the television through microcomputer programs. The most sophisticated of these is *CELESTE*, but an increasing number of more simple programs are becoming available. *CONSTELLATION*, for example, enables views of the stars from any chosen point in either the Northern or Southern Hemispheres – over fifty constellations being held in total. *STARGAZER* draws a star map for any time of the day or night at any time of year and allows enlargement of constellations and the display of their Zodiacal signs. Naturally the value of these programs depends to some extent on the skill and knowledge of the user. They should be used to support rather than replace the normal range of astronomical activities as found, for example, in the Ladybird book *The Night Sky, Adventures in Astronomy* (John Murray 1983) and the Learning Through Science Workcards, *Sky and Space*, (Macdonald 1982).

A second field for project-related programs is health education. *DIET*, for example, allows users to match their own daily diet in a graphical form with a recommended one and it could valuably support a topic on food.

Another type of program lays emphasis on helping children acquire knowledge and learn skills. Knowledge of, for example, parts of the ear or bones of the body can be tested, or practice given in reading meterological instruments (*UNDERSTANDING YOUR WEATHER* and *LOOKING AT SCALES*). However, purchase of materials which simply test facts is difficult to justify, since programs such as *QUIZ* and *MQUIZ* offer a much more interesting way for children to test their own and others' knowledge, and they have the added advantage of involving children in useful language, enquiry and collaborative skills. Many teachers would argue that the reading of instruments would be best learned from the actual objects themselves rather than with representations on a microcomputer screen, although the programs might be useful for preliminary demonstrations.

Simulations

If first-hand enquiry lies at the heart of primary science, any attempt at developing experimental simulation material, commonly used in secondary science, needs justification. The most doubtful application would be in experiments for which schools already possess apparatus – especially if the computer version is more tedious and creates less decision-making opportunities than real-life classroom tasks.

An example of experimental simulation is the program *DENSITY*. A range of activities is offered: a demonstration of objects floating and sinking in a bath (aims 5,6); a 'test' in which children must predict which of the several objects displayed sinks fastest or floats (aim 8); a definition of density; tables of volumes and masses from which a material's density must be calculated; and a card game in which the density of an object or material must be matched with its name. Further examples show the relationship between speed, time and distance, or principles of shadows and reflections. For some, these programs are an anathema having 'little or no place in primary school science. On the one hand they attempt to replace important practical investigations and on the other they do virtually nothing which could not be done equally well or better without a computer.' (Negus)[4]

Others argue that much depends on how such programs are incorporated into the science curriculum. If used alongside rather than instead of first-hand experience they may have a place in school, but with limited resources available such material should be viewed carefully.

Other simulations are often justified by claims that they are simply too difficult, dangerous or expensive to carry out in schools. Programs in this category are *BALLOONING*, which simulates a flight in a hot-air balloon over a changing countryside, *CENTRAL HEATING*, in which children can control certain variables which may effect the heating of a home, *GROWING A PLANT*, where children explore the environmental requirements of a growing plant and *BEES* where, after altering variables such as the distance of flowers away from a hive, the resulting 'bee dances' can be observed and analysed.

At their best, these programs involve observations, help develop concepts and logical thinking (aim 3), encourage children to pose questions and suggest actions which might answer them (aim 4), and help children appreciate patterns and relationships (aim 8). At their worst, the task can become a mechanical convergence towards the discovery of the 'right' answer or a mere game in which children develop successful 'winning strategies', but fail to understand the essence of events simulated. As with other simulations their use, too, would be best when accompanied by relevant practical experiments.

Classification programs

Many primary teachers will have used the program *ANIMAL* from the Micro Primer Packs which are being widely distributed throughout the country. Versions of this 'game' have been available for a number of years. Indeed, the idea is to be found in an original 'Dartmouth Basic' program and as long ago as 1969 a listed version of *ANIMAL* was available for general use.[5] In each case the computer tries to guess an animal's name with a series of questions. If unsuccessful, it asks the player to name the animal of his choice; then for a question to differentiate it from the computer's guess.

This type of program is popular in secondary schools because of its use in demonstrating important aspects of programming in computer studies courses. It also has implications for primary science. First, it is a category of computer material in which children program the computer as opposed to being programmed by it. In considering differences between animals, they exercise many skills including discourse, research and classification (aims 7/5/6/2). They begin to appreciate patterns and relationships (aim 8) and become critical in their choice of questions, choosing those which 'work better' than others (aim 9). In having to collaborate in the task, certain attitudes will also develop (aim 1).

Once such a 'game' is opened up to enable its use with any objects or materials – from football teams to food; clothes to clocks – then the potential is even greater. Several *ANIMAL*-type systems (program structures in which teachers and children can use their own ideas) now exist, such as *THINK*, *SEEK*, *BRANCH* and *TREE OF KNOWLEDGE*. With them, children can 'sort' all types of things including readily available material such as leaves and minibeasts. This enables genuine first-hand observation when determining differences (aim 2), one of the key processes in science. The subject matter can also be readily extended into the physical sciences. Illustrated is a section of the 'POWDER' file (Fig. 4) from *SEEK* and *THINK*, demonstrating that first-hand practical experimentation need not necessarily be omitted from a computer 'science' program.

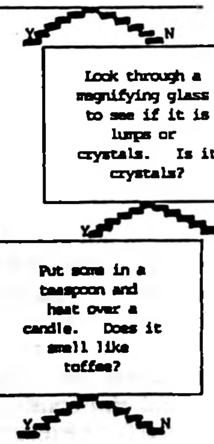

Fig. 4

SEEK and *THINK* have the advantage that files created on one system can be used on the other and a quick 'input' method (INTREE) supports them. They both print out children's 'sorting activities' producing a valuable record for them and their teacher. The print-out appears as a biological key, either in the original form or in code (Fig. 5). The latter can be offered to other children to 'solve'. This helps to develop their 'key-reading skills' and to test the suitability of questions other children have asked.

SEEK and *THINK* can also be used for identification of unknown specimens such as leaves, powders or fibres, as well as for the normal sorting tasks. All three systems can be used, in fact, across the wider curriculum and a book about the full potential of this genre of program is now available for those interested.[6]

CURRENT KEY

Question	*Yes*	*No*
1. Does it grind corn?	A	2
2. Does it lift things?	3	4
3. Does it need wind to make it work?	D	5
4. Does it work on trains?	E	B
5. Does it mesh together?	F	C

The Code: A – Waterwheel
B – Watermill
C – Pulley
D – A toy windmill
E – A piston and crank
F – Cog wheel

Fig. 5 Sorting of machines by children in 'code', with the answers below. The information can also be presented with *SEEK/THINK* as a standard key

Information retrieval systems

The sorting and classifying of information is taken further by information retrieval systems such as *FACTFILE* and *QUEST*. In science, noticing patterns and relations and classifying are important skills which can equally form part of a science lesson as one in the humanities. First-hand observation, for example, of minibeasts is already a popular activity in school. Children form groups to look under stones, on paths, in soil, and so on, and record their finds. Traditionally, such information is then displayed on charts and conclusions drawn.

Other details about movement, shape, number of legs etc. would then follow. With *FACTFILE* and *QUEST* such information can now be placed into a microcomputer. It can be edited, expanded and finally 'drawn out' for discussion. 'Let's look at all the places a wood louse is likely to be found.' 'Let's list all the creatures found under stones, which have six legs, and symmetrical bodies.' *PICFILE* has the added advantage of helping children perceive other patterns and connections by displaying them graphically.

Here again the subject matter can extend into the physical sciences and patterns can be similarly observed.

Certainly, when combined with first-hand activity, these programs can offer a powerful aid to primary science.

Date - October 4th					Class 2
Name	under stone	in soil	on grass	on path	on bushes
wood louse	/	/			

Fig. 6a

material/object	rolls	transparent	floats/sinks	conducts electricity	etc
jar	/	/	both		

Fig. 6b

CONTROL TECHNOLOGY AND PRIMARY SCIENCE

There are many ways in which control technology, through the use of the microcomputer, is developing and extending primary science. Consider, for example, the following description:

> 'At the beginning and the end of a staircase I place photocells and lamps. The photocells are connected to the computer. The computer can measure the time it takes a pupil to run upstairs. Every pupil is furnished with a piece of paper. They write down name, the length of the staircase and the time to run upstairs . . . The computer measures time and writes it on the screen. When all pupils have run, I wait until they have finished their calculations. Gathering in front of the computer, a push on RETURN and the table with names and results is presented on the screen. The pupils are given the task to sort the results from the fastest to the slowest one. When they are ready, a new gathering in front of the computer. A new push on RETURN and the sorted list is presented after a short while. Afterwards, we discuss the experiment. What sort of knowledge did you need? How fast did the computer work compared to you?' (Ahlstom)[7]

The potential for monitoring and supporting investigation in this way could well be a very rich one for future development and is under investigation. At present *TIMER* and *METER* are programs within this category. TIMER converts the BBC machine into an easy-to-use counting instrument which, with the interface device, can connect the micro to a mechanism in an experiment. *METER* measures AC and DC voltages and currents, recording and displaying the results in an analogue, digital or graphical form. However, the subject matter may still present difficulties for primary teachers, though there are accompanying suggestions for simple experiments with both packages.

Several other categories of activity which are appropriate to primary science are currently being explored.

First, a discovery approach can be used to build simple electronic circuits. This work can then be extended to design-and-make activities involving motors, lights, etc. Good examples of these activities have included making traffic-light and burglar-alarm systems and constructing control systems for model railways.

A second approach involves the use of 'black boxes', where functional electronics building blocks are assembled in Lego fashion in the design of new applications. These units are selected to solve particular problems and sequenced accordingly. This approach requires the minimum knowledge of microelectronics and demands imaginative and creative thought.

Thirdly, a high-level approach in which children investigate the environment by using microcomputer control of add-on constructions such as a vehicle, a doll's house environment, etc. This might involve using the micro to gather information by reading a variety of input sensors. Then, depending on the investigation in hand, the micro can be instructed to alter the environment in some way (adjust the temperature, operate a buzzer, switch on a fan, drive a motor, etc). Work in this area indicates that it is rich in 'real' problem-solving situations which, in line with the Schools' Council's central aim, can help 'the development of an enquiring mind and a scientific approach to problems'.

* * *

Science is a problem area of the primary curriculum and teachers need as much support as possible. It is often stated that there is little material to aid the teaching of primary science with microcomputers. In fact, programs are available which have many valuable applications. Others are being developed to retain the excitement of first-hand investigation and experimentation without replacing it. Clearly, the microcomputer has potential in this field, although further research and development is still needed.

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ELECTRONIC NEWS

This is a commercially produced computer program that enables children to simulate CEEFAX, PRESTEL, etc., and to display their information in an attractive and easily readable format.

Using the computer keyboard they can not only produce text on the screen but also build up graphical "pictures" of their subject, including colour and flahing blocks to further enhance their work.

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MRS.COX - DEPUTY HEAD

Mrs.Cox has been in this school for 18 years. The biggest mistake she has made is to forget to ring the firebell on a fire-drill. The improvement she would like to make if she was Head-Mistress would be to let people stay in at breaks. If she had another job she would be an archivist. The most embarrassing thing she has done is to read a funny story in Assembly and be unable to read on because of laughing!

CODES

As part of our project on communication we have been making up codes. Lisa wrote one for numbers and she made up sums for us to work out. Clifford made an alphabet code and called it the Gettings Code. Also we have been studying codes and signs. We looked at Braille, Roadsigns, semaphore picture writing, Morse code and hieroglyphics. They are on our classroom wall.

NEAR DISASTER FOR SCHOOL DISCO!

In aid of ETHIOPIA we are holding several discos to raise money for a fund. If you would like to see how we are doing the chart is on the left of Mrs Cox's door. Last night (Monday 5th November) we held one but the record player broke down and none of the records could be played! Luckily some people brought tapes and so we could play some music after all.

JOKES

Jokes-

LAUGH I NEARLY CAME TO SCHOOL

Doctor doctor I feel like curtains.
Well pull yourself together man!

Doctor doctor I think there's two of me.
Well sit down on the couch.
Which one?

Doctor, doctor, I think I'm a spoon.
Sit down over there and don't stir.

Doctor, doctor, I think everyone takes no notice of me.
Next please!

Using "Flowers of Crystal" in the classroom
by Reg Eyre and Sue Marlow

One of the major styles of software used in the classroom is the simulation package. Simulations can take on various formats and be used in many different ways but the classification I will use is to divide them into two; those attempting to emulate reality, typified by the "Mary-Rose", "Saqqara", "Sailing Ships Game", and "Predator-Prey Relationships". This type of simulation usually contains a certain degree of teacher controlled skills to be taught, (mostly about mathematical relationships), and can generally be fitted into named curriculum slots, such as history, geography, biology, etc. thereby making this type of simulation easy for a teacher to justify educationally.

The other type of classification of simulation is the adventure game such as "Granny's Garden", "Tombs of Arkenstone" and, "The Hobbit". This type of simulation is usually based in imaginative settings and has the aim of survival or collection of objects. This latter type of simulation or adventure game is claimed to stimulate the child's creativity.

My first experience with an adventure game written for school use was 4-Mat's "Granny's Garden". This particular program was highly recommended to me by teachers attending my courses, so I bought it for the College to show teachers on other courses what was being used successfully locally.

I found the program disappointing and tried to work out why this was. An initial reaction was "Where is the scope for creative and imaginative work?" Most of the openings for choices were actually closed, i.e. there was only one correct route, some selections were made tedious e.g. finding the magic tree, since its importance was minimal and its placing random. Eventually I decided that this particular adventure game would be of little use to me in my classroom, i.e. I would not be able to justify its use in my approach to the learning process in my classroom.

What was I looking for? After all, what type of creative and stimulating work could be got from the use of this type of program?

At this point in time, I ought to mention that I had met teachers who were able to stimulate pupils, of a cross-section of ages, into producing written work, based on the use of computer games. One teacher had secondary school pupils documenting the life and actions of a "snapper" from a Sinclair game as well as other scenarios based on computer games.

Both of these uses by the teachers were getting the children to write. However, the style of writing is documentary, it is about recording what has happened, the imagination being used is the program originator's and not the child's!

The first adventure game program which inspired me to want to use it with a class of children was "Flowers of Crystal". The package immediately seemed very complete. There was a background story which was on audio tape, in a book and could be put on a large monitor as well as a facility for printing copies from the computer. Maps, drawings and teachers' notes were included and, thankfully, fairly minimal.

What impressed me most were the minimal descriptions given to the characters in the story. This, I felt, was where the children's imagination could be left to run riot.

The manner I chose to use this program was to "borrow" two third year junior classes containing sixty four children. I explained that they were going to use an adventure game, but that first they would need to know the background story. I had a large 26" colour TV on which the computer would write the story, and an audio cassette recorder for playing the supplied tape.

I started the tape and noticed how the voice, with its attendant background noises, set an atmosphere in which every child's attention was totally captivated. At the same time as the voice was speaking, the children were reading the same words from the screen as well as making notes.

I stopped the audio tape early on and asked the children what image they had of a Blid – "an ugly, slimy, nasty creature which burrows in the ground". They were offering various judgements as to its colour, size, shape as well as its moral worth. I pointed out that I was interested in what they had to say about any of the characters they would meet in the story and let the story continue uninterrupted from then on.

At the end of the story, I demonstrated the actual game by randomly stumbling about within the game, and used this as a revision of their understanding of the story. The organisation from there on was explained, in that they were to work in small groups. About twenty minutes a day would be spent on the computer "doing" the game, while the rest of the time would be spent writing, drawing or making things associated with the characters in the story. The class teacher made materials available and from that point on became a provider and consultant, the impetus for work emanating from the children themselves.

Sue's own impressions of what happened, indicate the level of personal involvement and activity that the children were experiencing.

Adventures by Emily M.

I am at the centre waiting for my kit
The whether is quite cold ill have to use my wit
So along I take a very warm coat
A radio, disguise kit and soil tester I vote
And off I set (saying good bye Jim)
Along the path with a cheerful grin
A gloop sloop gloop oh dear
The Wids the Wids they are here
I fight them one two one two snicker-snack,
And they fight me ferociously back
I win, my way is clear at last
As they wiggle back everso fast
To the factory I go following the road
And as I come nearer I see a lorry with its load,
Of bubble-gum piled high and wide
With Grubble marked upon the side
I walk in through the open gates
dressed as one of grubbles mates
I find a slip of paper in the grass,
Horrah it is a "city pass"

cont.

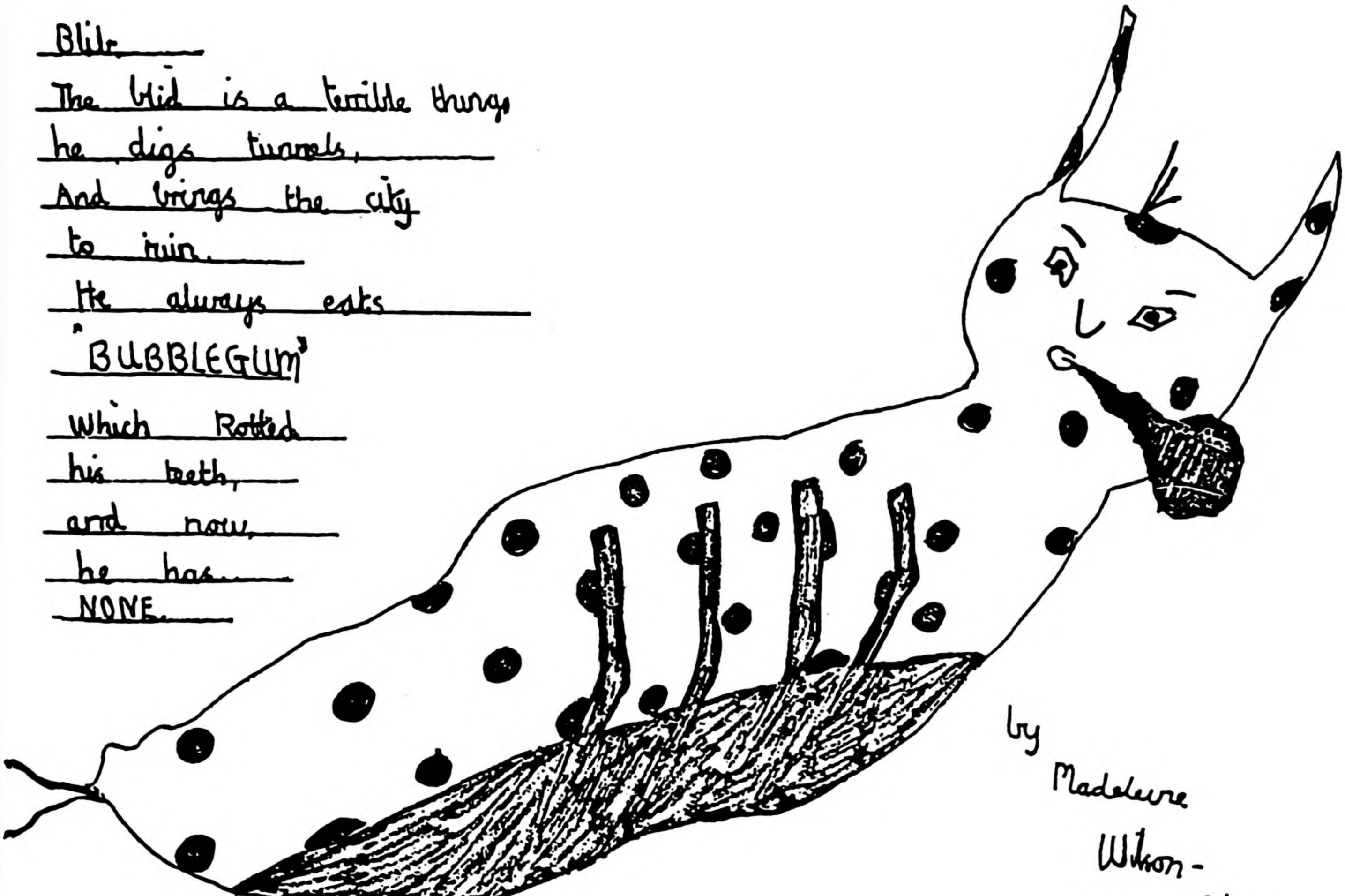
I think the "POUNCER" comes far too often and takes too long he makes me bored. I also think the "HOAROAR" occurs too often.

by Anjali Kwatra

I think the music at the begg-ining of part one is not very nice and I think there are far too many "ZAP-GATES" in the forest. I do not think part two is as good as part one because you do not have enou-gh area to make it a proper advent-ure and most of the wisdom stones do nothing.

by Nicola Mustoe

Blid
The blid is a terrible thing,
he digs tunnels,
And brings the city
to ruin.
He always eats
"BUBBLEGUM"
which Rotted
his teeth,
and now,
he has
NONE.



by
Madeleine
Wilson-
Chalon

Crystal Reflections by Sue Marlow

"Little did I think, a month ago, that the children would react in such a way to the program as to cover their classroom's walls and the adjoining room's walls with such varied work; from poems and stories to papier mâché and collage.

I knew nothing of the program, only that the children would hopefully be stimulated into doing some creative work. Beforehand I had told them they would be listening to a story from which they could write poems, draw pictures, and practise craft work. During the year they had been used to this approach in other subjects, but had not worked on a group project before.

Silence reigned as they listened and read the story, some taking notes. Then Mr. Eyre introduced them to the program, Adventure 1; how it worked and some of the things they would see ... they were then on their own!

Ideas flowed – different pictures of what a BLID looked like were being drawn, MR. GRUBBLE was taking shape, the workings of the factory were being designed. One group decided to use chalk as a medium, others followed: the same with the use of tissue paper. Each group (2 to 4 children) had a folder to keep their work in. They were very keen to keep their ideas secret from each other!

My role throughout this project was mostly of a supervisory nature; making sure the children had what they needed to do their work and occasionally to suggest new avenues to explore. The children were in charge of their own work.

Very rarely did I have to step in. The forest, containing the pot of gold, was proving difficult to investigate. I suggested they made a grid map, using squared paper, so they could record what they had found. These were kept in Top Secret folders – for their group's eyes only!

No other logging work was done while using the program (Adventure 1). The children seemed to remember what they had learned.

Once the forest problem was solved (Adventure 1) the children found out the number needed to begin part 2 quite quickly.

The second part proved more difficult. One child commented "You were more in command of where you went in Part 1".

Under pressure of time a third of the class joined forces to find the six parts of the flower. The screams of delight when all six were found were silenced when the screen told them "You have no more spells left". Ten minutes later they had found all six again! They then headed for THE FACE. "Do you want to use a spell?" "No" they typed. As time went on the children realised that this was the crucial question. So we've still not returned the flower, but the experience was of value to us all.

Some of the poems and stories written by the children have been appended, and we will let you judge the level of creativity and imagination displayed. What we cannot show is all the wall displays, art work and models that were built, nor can we let you experience the buzz of activity and excitement that makes this type of learning so much fun.

Tombs of Arkenstone; A Living Book in the Classroom by Bob Hart

MEP Chiltern Region AUCBE

SOME TIME AGO. . .

When I was a small child, I was in hospital for something – can't remember what, but someone brought me a few comics to keep me occupied.

I was absolutely fascinated with the pictures and writing, and I remember clearly that, although they were the same old comics, each time I re-read them, the stories were different!

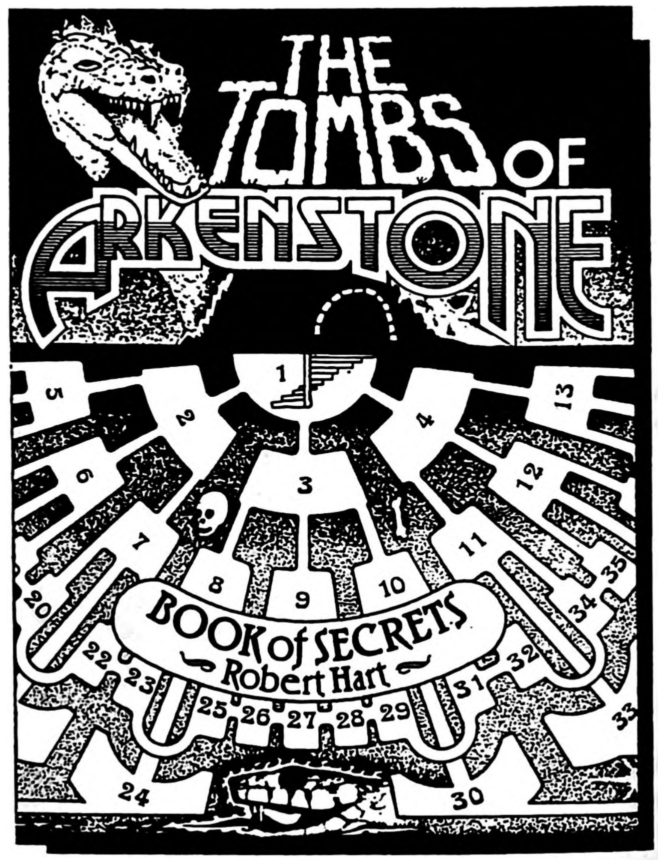
I probably got this impression because I was only half reading, and half inventing, as many young children do.

I was very disappointed when I learned to read properly and found that books had just one story, which didn't change. It was the same story when you re-read it. My original innocent concept of the fresh-each-time book was much more exciting.

I also used to LIVE the books I read. I would dream or daydream I was in the story. "I wonder what would have happened if?. . ." I became one of the characters – Huckleberry Finn was my favourite – we had a lot in common. Tom Sawyer and I used to go for adventures whenever life became a little dull – in boring maths lessons, school assemblies, or when I was out on a bike ride to Epping Forest or exploring the alleys of the East End docklands.

The faithful Watson (his Mum called him Charlie Blackett) and I solved many mysteries among the debris of bombed out houses behind Mile End Station and I survived with my friend Man Friday (Barry Chenovitch) and some stray cats for days in smelly old air raid shelters.

Books were something flexible to me. The magic of the words plus a little imagination defrosted those prepackaged stories and warmed them into life.



Thirty Years Later . . .

I was a Primary Headteacher, running a school for a community of GLC overspill families. We wanted to give the children a chance to get to grips with microtechnology, but at the same time to encourage their thinking, research and study, communication and co-operation skills and give them a taste of that total involvement in reading that I enjoyed as a child.

From the children's needs and my aims to develop the hidden metacurriculum of skills which seldom appear written on school timetables, we evolved together the TOMBS OF ARKENSTONE Project.

What is the Tombs of Arkenstone?

Basically it's an Interactive Book in the form of a STORY BOOK and a textual COMPUTER ADVENTURE Program. One of the most important features is the adventure authoring program called "MAKE YOUR OWN ADVENTURE".

THE STORY BOOK sets the scene:

The Evil Dragonlord has stolen the Elfin Ring. The runes inscribed on the Ring spell out a charm that raises the sun in the morning and sends it on its journey towards night. Without the Ring, the land of Arken would remain in darkness forever.

You will take your friends, and go to the Tombs of Arkenstone to find the Dragonlord. If you are clever enough and co-operate well, you might survive the attacks of his Dragons and Serpents. You must catch him, regain the Ring and save the Land of Arken from the Forces of darkness.

The computer adventure, allows the child to interact with the microworld of the story, as in the books of my childhood memories . . .

It's a new story each time s/he starts it.
Each child can become one of the characters.
Children can even take their friends into the story with them.

The story will change, as it unfolds according to the decisions the children make.

The children can also make up their own interactive stories for their friends to try, with the MAKE YOUR OWN ADVENTURE PROGRAM.

The Computer Adventure

In the computer adventure all the characters are set at random in the Tombs at the start of each new adventure.

The children are given a plan of the Tombs. With the wise advice of their Elf Friend, they can explore and encounter, the Dragonlord's monsters, Greedy Goblins, Touchstones, the Secret Passage, the Cloak of Darkness. They learn how to gain treasure and use the Circle of Lightning spell. If they meet the Dragonlord, they find he is a slippery customer and they must work out a clever strategy to trap him.

Role Play

The children adventure in groups of three, each child taking on a specific role and responsibilities.

The Hunter makes the final decisions on where to move, works out the strategy and looks after the plan. The Warrior decides when and how to fight monsters and the Magician makes decisions about Magic Spells. Some teachers let the children double up on each role, so that the adventure can cater for 6 children at a time.

Tombs of Arkenstone in the Classroom

The notes that follow are based on teachers' observations of children using the project in schools.

In most cases, the children worked with the project over a period of a school term or half-term. The main areas of value were in the development of:

1. READING SKILLS
2. THINKING SKILLS
3. COMMUNICATION SKILLS
4. COOPERATION
5. CREATIVE ARTS
6. ADVANCED READING, RESEARCH and STUDY SKILLS

1. Reading Skills

A twenty minute adventure involved the reading of some 4000 words and 800 numbers. They all had to be SKIMMED and SAMPLED for relevance and their MEANING extracted with SPEED and ACCURACY so that the adventure could proceed.

2. Thinking Skills

For each decision the children had to consider their STRATEGY, and the TOPOLOGY of the plan. They had to weigh up all the FACTORS of Magic, Time, Treasure, work out the POSSIBILITIES, judge their current PRIORITIES and consider the CONSEQUENCES.

Class discussions focussed on some of the moral issues: co-operation, consensus, democracy, freedom to act, responsibility for others, what is evil? What is good?

3. Communication Skills

Conversing

Since all decisions had to be agreed by all adventurers, the children needed to DISCUSS each move. Children had to argue their viewpoints and give EVIDENCE of their REASONING to fellow Adventurers.

Writing

Teachers found that the children wanted to write. They were narrating adventures that they had experienced only moments before. The experience was immediate and their involvement was intense. In many cases, the resulting work was surprisingly lively, vivid, colourful and flowing with easy narrative style.

4. Cooperation

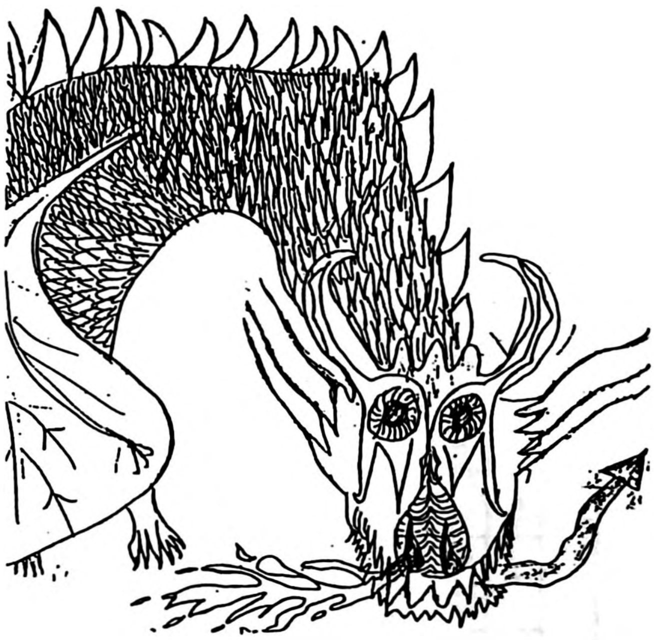
The Adventure is designed to reward co-operative effort. All three adventurers must agree on each move. The children gain Experience points for all successful hunting, fighting, and use of Magic. Each child's achievement benefits the whole group, who can all rise through the Experience grades and move on to higher levels of play.

By careful juggling of groups, teachers were able to encourage the integration of socially isolated children.

5. Creative Arts

Arts and Crafts

The project was a very rich source of inspiration for a whole range of art work – clay and plasticine monsters, puppets, paintings, prints, enormous paper serpents and tiny clay fantasy landscapes. Teachers found the lack of graphics was an advantage in that it left the children's imaginations free.



Denis' Dragon

Music Dance and Drama

Children took their ROLE PLAY during Adventures very seriously, and teachers were able to exploit this further in their Drama and Dance.

Groups of children also made primitive instruments to accompany the Dancers.

Fantasy

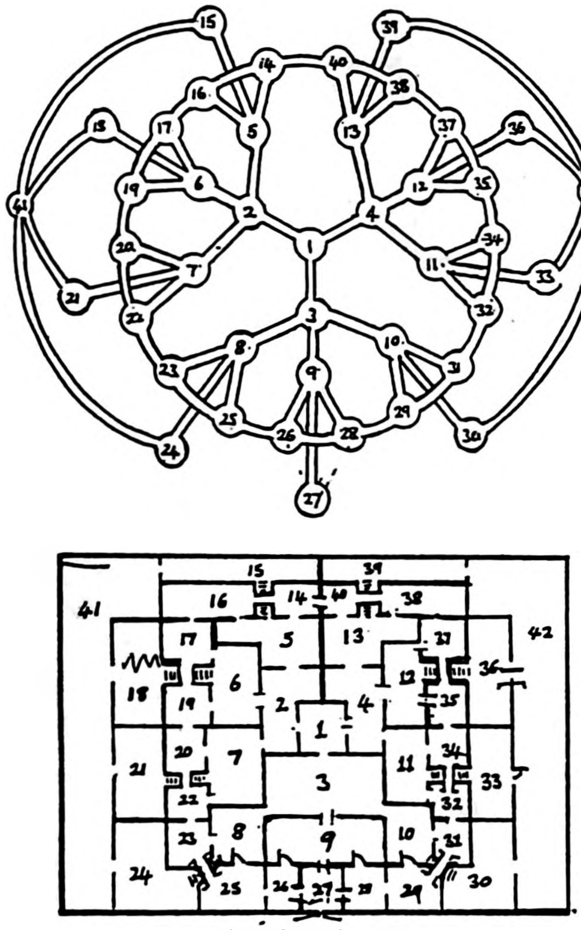
Every society recognises the power of its collective mythology – from the 16th century English elaborations around the history of Arthur, to the modern myth of the poor boy becoming President of the United States. No less important are the private and personal fantasies of childhood. Fantasy should be valued and encouraged as an essential psychological tool which we often use to explore both beyond our limits and into our darker corners, where lurk those inconvenient feelings like jealousy or fear.

It is interesting to note that many children chose, in their first adventures, to cast Parents and Teachers as monsters! But before you protest, I have also noted that Teachers often write adventures about Education Officers and Advisers, Advisers write about H.M.I. and H.M.I. like to write about Ministers!

6. Advanced Reading, Research and Study Skills.
Using the "MAKE YOUR OWN ADVENTURE" program, children can write their own adventures, set in any time or place, with characters of their own invention. These adventures can then be played on the computer within the logical structure of the original program.

Their adventures could arise from any project in which the children are involved.

Children created adventures set in a pyramid in Ancient Egypt, the catacombs of Ancient Rome, in Space, under the sea, in a Haunted Castle, on a Pirate Ship, and in the school itself, with teachers for monsters!



Plans for Adventures

The children had to organise their ideas, research the details, collate the information, enter it into the computer, design their plans (alternative plans are included in the User Guide) and then play and refine their adventures. A great deal of the work was carried out away from the computer, and teachers found that children needed a surprisingly deep understanding of their subject to be able to make their adventures.

Making adventures involved:

1. Formulating open ended fruitful questions.
2. Accessing Library, Catalogues and other media.
3. Collecting suitable resources in variety.
4. Directed purposeful reading.
5. Surveying techniques – Skimming and sampling to find relevant paragraphs, sections, ideas.
6. Reading for meaning, which involved literal comprehension, reorganisation, inference, evaluation and literary appreciation.
7. Study skills: the opportunity was taken to encourage children to explore new ways of collecting information and organising their work.

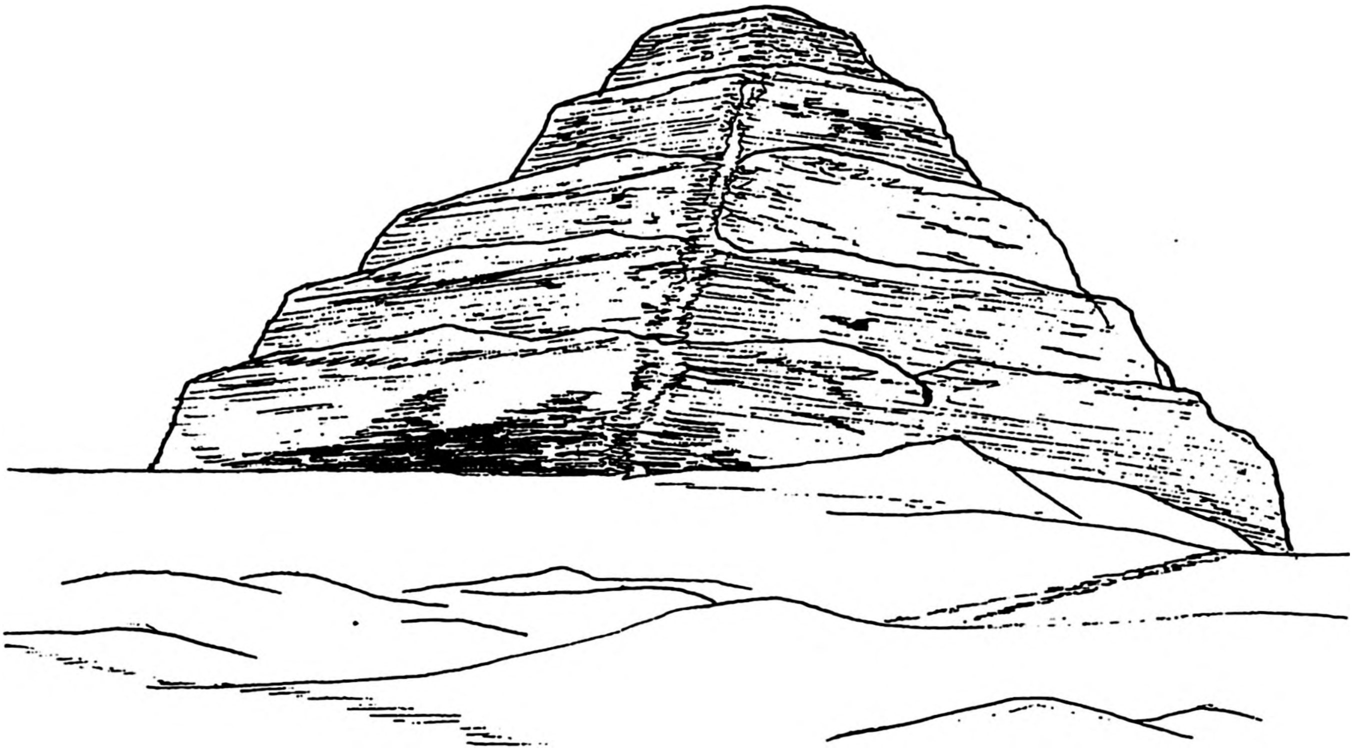
Power and Simplicity
There is a delicate balance between giving children the maximum power for interaction with a program and keeping the tasks involved simple and appropriate to the target age group.

BUT children always surprise us! The project was designed for children aged 9 to 14 years, but we have found in practice that much younger children, even 6 and 7 year olds are able to benefit from playing adventures. The next step is the design of a more powerful and flexible adventure generator. More of that soon!

REFERENCES
You can find out more about the Tombs of Arkenstone in:

1. Daily Telegraph – *"A Parents Guide to Educational Software".*
2. Open University – *"Micros in Action in The Primary School".*
3. MEP National Primary Project – Language Development INSET pack – "TALKING POINT" video.
4. MEP National Primary Project – Project Work INSET Pack.

THE TOMBS OF ARKENSTONE is published by ARNOLD WHEATON SOFTWARE, FREEPOST, LEEDS LS11 5TD
Cost is £15 + VAT
BBC cassette
BBC disc
Spectrum
RML (In production)



Saqqara Revisited (A personal reflection) by Ian Whittington

It now seems a very long time since my children first sank an imaginary spade into the sands of Saqqara, since they felt the excitement of their first 'find' and wondered what it was. I can still picture the eruption of diminutive humanity as the message flashed on the screen. I do not think that Howard Carter himself could have been more excited when he found the tomb of Tutankhamen. The children who did that, are now all at the local Village College and have, as the good book puts it, 'grown in wisdom and stature'. Our ideas of Saqqara have also changed a little. Further discoveries have been made by 'real' archaeologists, each one a small extra piece in the incomplete mosaic which is historical knowledge.

In the time that has passed since the project 'Expedition to Saqqara' was published, I have had the opportunity to meet with teachers who have used the program and have also read articles and reviews about it. The number of approaches to the project are legion. A few are limited in conception, but the vast majority show a breadth of vision and imagination which make me look critically at the way I approached the project with my own class. There are many times I have said to myself 'Now why couldn't I have thought of that?' The experience has been professionally refreshing.

Because I always seem to be busy developing new ideas, both historical and otherwise, it has not been possible to 'revisit Saqqara'. However, as I write this article I contemplate using the program next term with my present class. As I consider the various options open to me, my thinking is coloured by those teachers I have met who have used the project and used it well. There was the teacher in Haringay who had his multi-national class preparing Egyptian food, another in Cambridge whose art work left me open-mouthed . . . I could go on . . .

But it is not only the teachers it is also the children. I remember Rupert whose attention was very frequently distracted by what the other groups were doing. I was concerned because I felt that he should be occupied with his own work rather than looking at the actions of the other groups. The concern was the usual teacherly concern for a child who is not 'getting on'. However, closer examination of his book showed it to be immaculate and furthermore showed that he was keeping a careful eye on where everyone else was searching – so that he wouldn't have to waste time and money searching there himself. His finished account of his expedition to Saqqara was a joy to behold.

While we were 'in Egypt' President Sadat was assassinated and one boy wove the incident into his own account, finishing with the words . . . 'We have not started out to work so early this morning because of this death.'

A visit to the British Museum led one particular boy to call to his friends as they passed a glass case 'Hey . . . look fellers WE found that'. That remark certainly stopped a few visitors in their tracks!

Professor Smith of London University, provided another treasured memory as he crouched down by a mummified bird and described to two fascinated children how he and his team had discovered it deep underground. Later the children wrote to him and he replied to a number of them at their homes during the Christmas holiday, in letters which were as charming as they were individual. As far as I can remember, one began

'Dear Rebecca,

I was delighted to hear that you had found those particular items . . . do you know . . . the French Egyptologist Auguste Mariette found some just like yours in 1851'

Those who say that anyone undertaking to create a project of this kind learns a great deal themselves are certainly correct. My wife and I studied many weighty reference books and visited a number of museums. It was fascinating to see the notes kept by the archaeologists about their workers and their pay, all meticulously recorded in small books in spidery copper-plate writing.

The most important lessons I learned were about the teacher-child relationship. With a project like Saqqara, even if the teacher has researched the project initially, he cannot know everything . . . nobody does. The teacher and the child have to be fellow explorers. The teacher is not the fount of all knowledge. He has to be prepared to say that he does not know all the answers. Ideally the teacher should be in the role of an 'older and wiser fellow explorer' with the children, sharing in their delight and wonder and supporting them when they encounter problems.

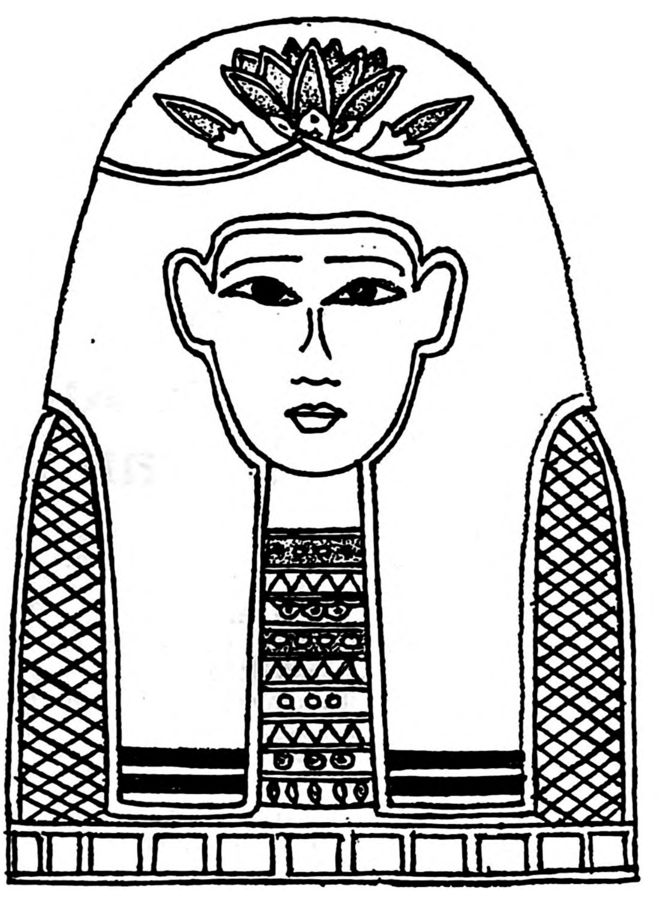
One of those 'problems' is the provision and use of reference books. There can never be enough of them. They seem crammed with information – except for what you need to know.

On occasions reference books can be contradictory. Spellings of Egyptian names can vary greatly. Unas has his pyramid to the south of the Step pyramid of Zoser . . . or should it be Wynas and Djoser?

It was interesting to observe the way in which groups got on with each other – and the way in which they didn't! (Very much like adults really.) Having a class which contained both third and fourth year children I decided to group two third years with two fourth years. I thought that the fourth years would help the third years and that the latter would be gradually eased into the idea of a large scale simulation. The result was that the fourth years sat in front of the computer keyboard and the younger children were relegated to the sides. On the occasions when one of the younger children dared to reach a finger forward to initiate some course of action the finger was gently pushed out of range of the keyboard – usually without a word being spoken. It was not so much a wish to always press the keys it was a desire always to make the decisions and carry them out. Perhaps all the best archaeologists need to be autocratic?

However, I could see that the two third years were not being given the opportunity to make decisions regarding the search or the excavation of tomb sites. Very soon I had soon put an extra line in the program. – On a number of future occasions that group were confronted with the words 'The two oldest members of your group have contracted dysentry and are unable to work at the site today'. The younger ones then had the site to themselves for a day. They did not hide their delight. The 'RND' in the program line ensured that dysentry recurred frequently enough to ensure a degree of freedom of action for the younger members of the group – but not often enough to be physically – or intellectually debilitating! This feature is not in the published program.

Yet of all the memories of the Saqqara project, the most enduring are of the delight of the children and the wonder of ancient Egypt itself. Yes – we must explore it together next term.



Flexibility "Wouldn't it be nice if . . ." by Barry Holmes and Steve Fletcher

St. Helen's CP. Cambs.

Most of the computer simulations that we have undertaken always seem to start with the words "Wouldn't it be nice if . . .' or "I wish we could . . .". Thus, 'Saqqara' started from,

"Wouldn't it be nice to go on an archaeological expedition with the children, and give them a real sense of history!"

Obviously, it is impossible to take the children out to a real site and dig for the period of time which would be required to gain any real benefit; nor would most archaeologists appreciate thirty-five children running over any significant sites! It was with this in mind that the idea of a computer simulation began to evolve.

A professor of archaeology was approached and his advice regarding possible sites and specific information about those sites was sought. The necropolis of Saqqara was finally chosen after lengthy discussions, and a period of intense research commenced. Next, the program was designed, the structure of each of the tombs being plotted and translated into data statements for encoding. Finds were allocated to each of the tombs and either drawings or inscriptions were prepared as additional classroom resources to accompany the program. Six months had elapsed from conception to the first classroom trials. The need to be able to program was essential at this period as few companies were publishing primary software. A similar time scale and design problems were encountered when designing the 'Mary Rose' program. There were many problems in the early days, not least being the actual programming; the average simulation took over two hundred hours to program. The real value of these programs only becomes apparent in the classroom where they are intended to open doors through which children can explore areas of interest whilst still being guided by the central theme of the simulation. This must surely be regarded as one of the simulation's major strengths.

Specific simulations will always have a place in primary computing, partially because of their complexity, but also because of their relevance to particular curricular objectives. However, it will become increasingly important to develop programs which allow teachers to decide their own journeys and eventual destinations. The freedom to choose relevant sites to explore in response to the question "Wouldn't it be nice if . . .?", without the need to spend many lonely hours programming, will appeal to many. The release from the task of programming, combined with the facility to develop specific data relating to the local environment and interests and present it in a new and stimulating way, will be one of the most important developments in educational software. The importance of this type of "content-free" program which allows a great deal of flexibility on behalf of the teacher is already recognised by many. The emphasis on the releasing of the individual to pursue their own interests cannot be stressed too strongly. It will inevitably play an increasingly important role in primary computing. The flexibility affords opportunities for individual creativity.

In the field of archaeological simulations based on the theories developed in programs such as 'Saqqara' and 'Mary Rose', the program 'Archaeology' has been designed to further include this element of flexibility. The program gives the teacher the opportunity, for example, to research in depth local or specific sites of interest and easily enter the details into the computer. For instance, a teacher may wish to study a Roman site which is in the immediate vicinity, such as the Palace at Fishbourne for those in Portsmouth, or explore a site of current interest, such as the Viking settlement recently excavated in York. The possibilities are merely limited by our creative imagination. The questions which we wish to raise need not necessarily be constrained by the past. The sites we may explore can be in the past, the present or the future.

The importance is not solely the type of site, but increasingly the questions which are raised in the minds of the children, and the quality of the language that is generated by the highly stimulating activities. For example, one of the ideas that arose during the preliminary trials was the excavation of our own school. First, a group of third year children, as part of a mathematics program, mapped the school. This information was then plotted into the computer using the first part of the 'Archaeology' program. Relevant finds were chosen and these, along with specific areas of flooring, were also positioned within the plan and entered using the same program.

Using the second program, the fourth year, without prior knowledge of the origin of the site, commenced excavation. They started knowing only that the site was somewhere in England. Details of its period and nature also remained a secret. The excavation soon produced evidence of a building or buildings, and quickly led to the discovery of certain artifacts. The first was an Allen key, which although readily recognised as the key for the fire alarm, was recorded as Find 19 – Bent Metal, and its significance initially was ignored. The second find was a plastic spindle from a computer printer. This aroused considerable discussion as its purpose was not known. Although the exact purpose of that artifact was never discovered, it became one of the most significant finds. Class discussion led to conclusion that as the artifact was made of plastic, the site must be fairly recent. This hypothesis was further supported by a number of other finds and also by the nature of the floor segments found around the site. A gradual recognition of the excavation followed as walls revealed further details of the site.

Areas of knowledge which the children applied during the excavation were extremely diverse. Naturally mapping the site required certain mathematical skills, recording the finds and writing the daily diary depended upon their artistic and linguistic abilities but of prime importance was their ability to hypothesise logically about the finds and their significance in helping to identify the site. As this was a class project the discussion of the theories by the whole group was a regular feature.

The example cited above illustrates the "open-endedness" of the program, but it should also be mentioned that it has been designed to be as "user-friendly" as is possible. So just what degree of computer knowledge or skill is required by the teacher?

'Archaeology' is in effect a suite of programs. The first program enables the teacher to enter details of a site of his or her choosing. It is necessary to have researched the site and to have prepared a plan on a sheet of graph paper. Details should include the walls, flooring, artifacts and other relevant details that are to be included in the excavation site. It is possible to simulate a site on three levels, and the details are entered in sequence. The walls, floors and finds are entered in that order on each respective level by using a simple LOGO- type program which is controlled by the cursor keys and a small number of other keys, for example, 'A' to add a find, 'B' to build a wall and one of the relevant number keys to change the level.

Using the second program, groups of children can excavate the site plan that has been entered by the teacher. Once again, a limited number of keys are used along with the cursor keys to excavate quadrants or trenches. When the group have positioned the cursor over an area that they wish to excavate, the 'D' key is pressed. A square "cross-hatched" area appears on the screen and this indicates that an area of one square metre has been excavated to a depth of one metre. The "cross-hatching" intensifies as the group digs deeper. Groups may be restricted to specific areas or allowed the freedom to explore the whole site.

If a particular site is too large to be included on a single database, then the site may be sub-divided and the groups can work on the different sets of information independently. For example, a village may be chosen as the site and a series of specific areas mapped independently. Thus, one group may excavate the church and surrounding area, others, houses in particular streets, and yet others, specific buildings such as the village school. The information gained by each group can then be pooled to develop an overall picture of the site. Again, this can equally apply to historical settlements such as a Roman town, or to the modern connurbations in which the children live.

Ancient Egypt when writ

Other possibilities readily present themselves. By slightly altering the method of plotting the site i.e. using co-ordinate points rather than blocks on the plan, the children can explore a site such as an old ship where the curves can be simulated by points, as with the 'Mary Rose'.

Although the original intention was that the program should be used for historical investigations, other applications have already come to light. For example, one infant teacher plotted the classroom and the children were asked to find a particular object. This was only on the first level, but the emphasis was on the children forming a strategy to discover the hidden object rather than excavating the site. Another idea that has been put forward is that of using the program to encourage contextual letter and word recognition and the prediction of letters and words to come in a part revealed sentence. For example:

Level 1: MUMMY WAS
Level 2: WITH MY
Level 3: BABY SISTER

Each group of children would dig away the letters revealing as much of them as was needed to recognise and guess the words, predict future words, and sentence content. Other possibilities such as cartoon-type pictures and shape recognition have been suggested.

An interesting observation made recently on simulations was that it was the people who design them who gained the greatest depth of understanding. Most certainly Ian Whittington, author of 'Saqqara', acquired a very great depth of understanding of Ancient Egypt when writing the program, and David Jackson's knowledge of foxes increased considerably whilst researching Suburban Fox. If teachers and pupils can research and develop their own sites then those benefits may be shared by many others.

Further, another of the benefits of the production of information by individuals and the pooling of resources will be the greatly increased number of projects available to teachers. One teacher can study a particular site, the information pack and disk containing the data can be lodged at the local Teachers' Centre or in the school, and can be loaned to other schools. This will allow a library of projects to be built up and increase the variety and number of computer projects available to teachers. A further way in which co-operation between teachers can take place is typified by the project based on a site in Colchester. From information provided the pottery teacher at our local comprehensive school readily agreed to produce some facsimile pots. The designs were in fact taken from authentic archaeological drawings provided by the curator of Colchester Museum. The pots were then smashed so that the children actually discovered sherds and attempted to reassemble them. This enabled the children, as closely as possible, to experience the thrill of discovery and identification of the finds.

In this instance the finds have been facsimile pots and drawings. Other possibilities, once the idea is mooted, readily spring to mind. We are currently looking at the production of other artifacts, such as brooches, pins, and parts of a sword, again using the good will of a local metalwork teacher. Another alternative may be to borrow actual artifacts of the period from the School's Museum Service, or a local museum. It is this notion of the teacher using the resources of local museums, colleagues, and on occasions real artifacts, which will broaden the scope of this simulation.

In our experience, simulations encourage a very positive involvement. In the case of archaeological digs the discoveries that are made are personalised and this almost always results in a deeper understanding and a more enthusiastic quest for knowledge. Visits to museums are made with greater interest and the artifacts studied more keenly.

For the teacher, the satisfaction of producing their own simulations will be rewarded by the undoubted enthusiasm of the pupils. The question, "Wouldn't it be nice if. . .?" can be answered as far as the archaeological project is concerned, by 'Archaeology'. In the future, the same question related to other project areas and simulations will be answerable by a similar type of program. The freedom to use the computer to develop a variety of simulations will not be restricted by the quality of the individual's programming.

NB

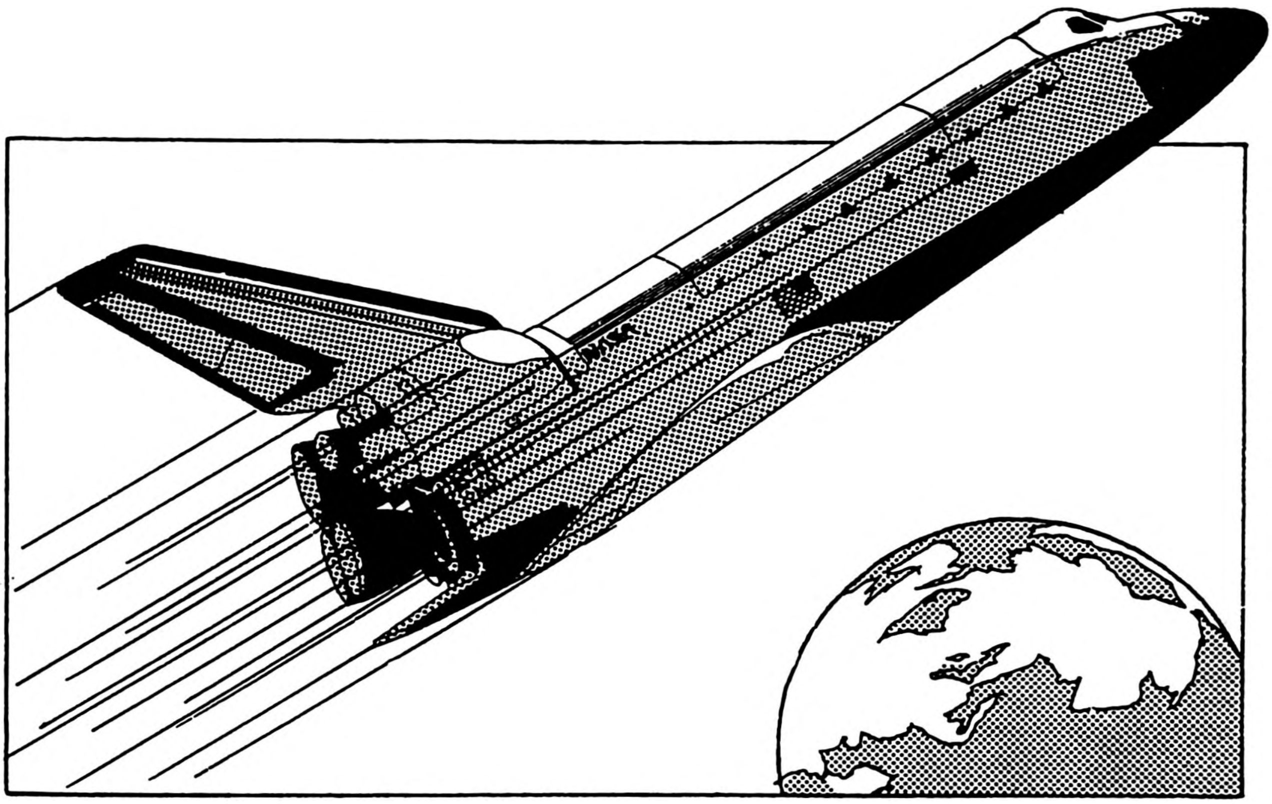
This article is taken from the book "The Child, the Teacher and the Micro" written by Barry Holmes, Ian Whittington and Stephen Fletcher. The book is published by,

Cambridgeshire Scholastic Services,
The Town Hall,
St. Ives,
Huntingdon,
Cambs.

and will be available early in 1985.

A database on the Fishbourne Palace is available from,
St. Helen's County Primary School,
Colne Road,
Bluntisham,
Huntingdon,
Cambs.

Please send a blank formatted disk along with 75p worth of stamps to cover the cost of postage.



"Flight" with Fourth Year Juniors by Andrea Tapsfield and Stephen Booth

Newman College, Birmingham, and
St. Peter's C.E. Primary School, Bury

"Introducing Geography" is a package of four simulations published by the British Broadcasting Corporation for pupils aged 10-12. The software can be used in association with programmes in the BBC Schools Radio series of the same name that will be broadcast in the Summer Term 1985.

The four programs are called RIVER, FLIGHT, SUMMIT and NOMAD. The first two were written at Newman College, Birmingham and the latter at the Advisory Unit for Computer-Based Education, Hatfield. Each program presents the pupils with a problem to solve in a different type of environment. For example, in RIVER you must try to follow a river to find safety, after surviving an aircraft crash in a remote region, while in SUMMIT you must climb EVEREST from Camp 2.

An initial stimulus

The aim of the programs is to introduce junior and middle school children to conditions in different environments, such as mountains and deserts, and widen their geographical vocabulary through decision making. The programs and the radio broadcasts are seen as an initial stimulus for project work away from the computer to encourage the use of reference books, atlases and other resources. From the outset the programs were written to motivate children with colourful graphics, and pose problems that require pupils to plan ahead, adopt a strategy or research for required information. The programs were designed to be easy for children to use so that there is very little support documentation required, instead help and instructions are given on-screen where required. This leaves the teacher the flexibility of incorporating the program into his/her own geography topic. It was not envisaged that any class should use all the programs consecutively!

The programs were used in a number of primary schools during 1983. At that time the broadcasts were not available to use as an introduction to the programs. Teachers adopted their own approach to the use of the software, and as a result of suggestions made, certain programs were adapted to make them more flexible for classroom use. For example, a "demo" program was included in RIVER to allow a teacher to access each scene separately rather than always running the program from the beginning. This enabled teachers to use the "gorge" scene in an "electronic blackboard" mode to demonstrate the drawing of cross-sections.

The description that follows is from one of the schools that used the program, FLIGHT, as the basis of a geography project lasting half a term with top juniors. The main aim was to reinforce the atlas skills developed earlier in the curriculum, but in addition, it was hoped to give the children the structure to pursue their own research from reference books and to do a project based on this reading. We were successful in the first of these aims but the development of the project work could have been better.

Planning and researching the route
FLIGHT puts the children in the role of a long distance airline pilot and navigator. They have to fly their aircraft safely over mountains and oceans to far-off cities, but to do so they must plan and research their route beforehand. Once the program is loaded (it is a disc only program, loaded by SHIFT-BREAK) the children select their route; the choice is to Los Angeles, Johannesburg, Adelaide or Buenos Aires. Each of these routes is split into refuelling stops, the route to Adelaide having the most stages.

Children work in groups of two, one being the pilot, one the navigator. The latter collects a flight plan and the team's first task is to write down their call sign and then the details of the stage of their journey. The most important information is the scrambled names of the cities en route.

The team is then instructed to leave the computer and complete the plan by entering the salient geographical features to be encountered. This is a crucial ingredient of the program. The most valuable work – discussion, planning, problem solving, identifying mountains, rivers, seas, settlements, working out the distance using the scale and the direction from the alignment of the map – takes place away from the computer. Whilst this work is taking place, other teams are visiting the computer in their turn.

Taking Off
Once the plan is completed, the team returns to the computer in order to fly the stage. Typing in their call sign takes them to the correct part of their flight. Before take-off, the direction, distance and the names of the scrambled towns must be correctly entered. Then the take-off is simulated on screen and once successfully airborne the screen splits into three vertical panels. As the flight progresses, information on height, fuel, speed and distance travelled is displayed in the right hand of these. It is the pilot's job to monitor this instrument panel and keep alert for any "danger" signs. Four red function keys control speed and altitude.

The middle panel gives a graphic representation of the terrain the team is flying over; sea, desert, mountains etc. The navigator's task is to identify the features, to instruct the pilot as to altitude (if mountains are looming) and to provide the answers to the occasional multiple-choice questions in the left panel. In addition, the navigator should note other features displayed from time to time in the full width horizontal panel. The role of the navigator is far more important than that of the keyboard-operating pilot. The emphasis is on the co-operation between pilot and navigator to achieve a successful flight.

The project was launched with a class lesson demonstrating the program. It was decided that all the children would fly to Los Angeles on their first flight, so that the idea of the flight plan could be taught step by step together. The flight plan for the first stage from London to Reykjavik was constructed as a class lesson. Most children found that they could cope on subsequent stages without much help from the teacher. However, our class atlases proved inadequate for the detail demanded by the program. It proved difficult having to consult two separate maps (physical and political) of the same region, especially when they are not drawn to the same scale. As a result some children (too few!) brought atlases from home and there was often a queue waiting for these to be free.

The children enjoyed the simulated flight and usually completed the stages satisfactorily. Those who did a sloppy plan either crashed, or landed safely but were told the navigator needed more practice. The consequence of either of these is that the team must complete that stage again. Three mistakes are allowed in answering the questions; a mistake is identified with a buzz from the computer. Flying slower lengthens the time available for answering.

After the Flight
On successfully landing, which requires the pilot to approach at the right speed, the next task is for the children to write up their work. The flight plan provides the basis of notes for the children to do this. By now the plan has been augmented as the navigator should record the information displayed en route. This information provides the branching out for further reading. For instance, a flight across the Atlantic Ocean will highlight fishing, whales and icebergs. The above average child has the opportunity to develop the work in a really ambitious way. All sorts of art, craft and other work could be developed by the teacher. The less able could write their flight as a simple log book.

It was in this area that our fourth year juniors did not shine. This was not really their fault. The class teacher had already planned to do a major project based on "How We Used To Live." and she was asked to include this work as an extra and at short notice. Consequently not enough time was made available for the children to tease out the full potential of the program and appropriate reference books had not been ordered from the town's library project loan service. Much of the introductory work was rushed. Having developed a program, classroom trials are demanded as a matter of urgency!

Once the written work for each stage is completed, the team reverses roles, returns to the computer and begins the task of preparing a new flight plan for the next stage. When the whole journey has been completed, a certificate stating the call sign and route may be printed out for the children to keep. This proved to be very popular. However there is a snag here; on the version we had, the program crashed after a printout and the computer had to be switched off then on again before the program would run again.

Evaluation
Enough work was done however to say that this program does provide an ideal core for a geography project lasting in the region of half a term. The children's atlas skills visibly improved and they gained much information about the countries and seas over which they flew. Next year it is hoped to build on this experience and to make more of the opportunities to develop study skills and subsequent written work and mapwork.

Some of this term's approaches proved successful and will be repeated; the class introduction to the program and the introductory class work on the flight plan. The children will all complete the same route for the first flight, then subsequently the teams will be free to choose. A more leisurely introduction and allowing more time for follow up work will, it is anticipated, give the children the opportunity to present a much more ambitious piece of work; one that will do justice to this program.

Journeys into a Microworld by Allan Martin

St. Andrew's College of Education, Glasgow, Scotland

Echoes from a Bygone Time
From "The Diary of Mary Bell":

9th April 1884

I am 15 years old. I have just lost my job.

The Rev. Jeremiah Burns has just said to me "You'll have to go." Why, I ask myself. Does he dislike me? Do I take too much pay? Do I drop too many things? Am I not cleaning everywhere properly? How on earth will I get money to live? Where will I go? What will my family think? I wonder what will happen next. Tomorrow I hope to tell more.

From the "Book of Letters of Victoria Alice Stewart-Forbes":

Allt-na-Spey House
10th June

Dear Marjorie

You won't believe this but it is definite that I am marrying Malcolm. It's so exciting I simply can't wait, although we haven't set a date yet. I'm sorry I haven't written for so long, but I have just arrived at Beatrice's. She has set out a lovely room and there is a marvellous view from the window.

I must go now for my tea. I will try and write back soon.

Your Friend
Victoria

From "Incidents which may have occurred in Scotland whilst journeying 100 years ago":

Callum MacPherson was robbed on 6th April 1881:

I sat down beside a tree for a rest after walking from Kilwinning to Ayr. I fell asleep. When I woke up my bag of clothes was gone. I asked the villagers that lived close by. One of them said that they saw a man with a bag over his shoulder, and he had a black hat, a black cape, and a black suit on. I was determined to find the robber, but I would need to find him quickly because I needed to travel on to Paisley. I never found the robber, but I found two things that were mine lying in the bushes.

These extracts are taken from material generated during a trial usage of *Scotland 100 Years Ago*, a package produced by the Simulation-Database Project, St Andrew's College of Education. *Scotland a Hundred Years Ago* is currently being evaluated in use in primary and secondary schools. A class using the package may be divided into up to six groups. Each group takes on the identity of a fictitious but authentic character. The characters are chosen to represent the full range of social standing: Mary Bell, a housemaid, Jean Muir, a labourer's widow, James Gordon, a clerk, Andrew Douglas, a journalist, Callum MacPherson, a lawyer, and Victoria Alice Stewart-Forbes, an aristocrat. The material refers to the journeys round Scotland a hundred years ago of these six characters. Each group is presented with a scenario requiring their character to make a long journey across the country. The journey is planned, then movement is made using the computer-based movement-simulator (based on the "adventure game" model) which forms part of the package. During movement, authentic incidents may befall the characters, and they may acquire and lose possessions.

The amount of movement permitted at one movement-session is limited, so that frequent pauses are made in the journey. At each pause, a variety of work may take place. This may be creative, descriptive or dramatic work arising out of the leg of the journey just completed. It may be investigative activity concerning the zone arrived at. Or it may be route-planning or other preparation for that part of the journey still to be completed. During this phase the two computer-held databases may be consulted. Database 1 contains a series of passages of information which can form a basis for various activities. Database 2 contains a list of sources, book and non-book, which may be followed up.

The package also includes a set of 30 contemporary photographs, story-sheets giving details of the characters and their required journeys, simulated letters and other documents, and three user manuals.

Activities arising out of the package in its use so far have included mapwork, creative writing (diaries, newspaper reports, descriptions), drama (plays, taped interviews with characters), discussion, historical and geographical research and the presentation of findings, art and craft work (drawings of scenes and situations, friezes, models), field trips and visits to the schools by outside speakers. These activities may involve language (both written and oral) and number work. An important feature of project-based activity is group interaction and co-operation: plans must be made and tasks allocated and executed within each group, using the talents which the group possesses.

One indication of the activity achieved during the package use (which usually lasts for between half a term and a term) is the range of materials produced. In addition to the compilations of pupils work quoted above, other diaries, sketch-pads, books of poems, newspaper articles, and "Scripts of Thoughts and Conversations" reflect the travels of the six characters all over Scotland. Four large volumes are entitled "Complete Guide to Scotland". They include drawings, handwritten and typed letters, poems and descriptions. There are also occasional print-outs from the computer: a map with the legend "You are in the town of Peebles" and an arrow pointing to the spot; an account of "Travelling to Oban"; details of a book on deer-stalking. Other items have been pasted in: a cutting from a newspaper showing a photograph of an Edwardian football team; a photocopy of a page from a nineteenth-century directory.

Looking round one primary classroom where the package is being used, six larger-than-life figures in Victorian dress catch the eye at once. They peer out of a crowded abundance of display material on the walls. The general atmosphere is one of purpose and activity. Two things are not noticed at first: the teacher and the computer. At last the computer is spotted, almost in a corner, with, at the moment, no-one using it. Plenty is happening elsewhere however: two typewriters are in action, one an antique lent by a parent, the other the teacher's more modern portable; three children are tape-recording an interview; four are building a model of a village; others are drawing, writing, measuring and (in suitably low voices) discussing. The teacher sits among one group, taking part in their discussions.

Scotland 100 Years Ago is still being piloted; although the enthusiastic reaction and participation of children and teachers, and the benefits which they feel accrue from its use, guarantee that this package will become more widely available. This package is however only the first to be produced by the Simulation-Database Project. Developments currently under way have a much wider curricular and national relevance.

The Simulation-Database Project

The Project, funded by the Scottish Education Department, was established in April 1983. Its main objective is to explore one way in which computers may contribute meaningfully to the work of the school, by developing and evaluating *simulation-database packages*. A simulation-database package consists of three elements:

i. A "movement-simulator", based on the by now well-known "adventure game"" model, enabling participants to move around, between "zones", encountering various situations and incidents, within a particular "micro-world".

ii. Two databases, one of passages of information relating to the zones accessible through the movement-simulator, and the other a series of further references and sources, book and non-book (searches being possible on the basis of both zone-name and subject-area).

iii. Relevant and useful ancilliary materials, such as handbooks, maps, facsimiles of documents and fictitious documents of authentic character, and pictures.

The simulation-database package supplies a continuity element as well as a key resource for topic work in a primary class. It will support activity for the period of time considered appropriate by the teacher. The movement-simulator provides a framework of travel and incident, the databases will make available items from a collection of information, and will enable the user to pursue his/her enquiries through consultation of further sources. Ancilliary materials provide the teacher and pupils with further support. Each of these facilities gives the user, whether teacher or pupil, a wide range of choice; and therefore the opportunity to explore fully a particular learning environment.

Using a simulation-database requires the use of disk-drives, for rapid access to large amounts of information, and a printer, for production of hard copy to be taken away from the computer to be used in work activities. Only with these two key peripherals can the full potentiality of the computer be realised. That this is recognised in primary schools is indicated by the numbers which are acquiring, first disk drives, then printers. Reductions in prices, and the appearance on the market of lower-cost units has helped schools in this respect.

The Computer as a Learning Tool

The assumptions underlying the Project's work are that computers are powerful instruments for information handling (in its broadest sense) and therefore must be present in the classroom; but that their contribution to classroom activity must be appropriate, and must be fully integrated with the contributions of other, equally useful, tools for learning. Software is a central element of the package; however, the computer is not the focus of activity. It is significant, but discreet, doing what it is good at, while permitting the locus of learning to remain at the workspace of each group.

A simulation-database package is not therefore to be used in isolation from other teaching resources; it is one of a range of learning activities made available in the context of a particular area. "Hands-on" time at the computer should be short, since it is intended that most learning will take place away from the computer. Material produced by the computer (passages of text, references, maps, diagrams, instructions and progress reports, etc.) may be taken to the work-tables to form part of the learning activities. The inclusion of pictures, maps, story-sheets and extensive documentation is another indication that the computer-based learning package cannot consist merely of software if it is to be fully integrated into classroom activities.

Many teachers find that packages which they purchase are not quite suited to their locality or their class, or see ways in which extra features could be added. An essential characteristic of the simulation-database is that it should be easily adaptable and extensible by the user. New data can be easily added, and existing data easily replaced. Thus any simulation-database can be adjusted to local conditions or to the particular objectives and interests of a particular school and its teachers and pupils.

The use of LOGO as a programming environment for the development of simulation-databases makes possible such modification. LOGO is often mistakenly thought to be a "turtle graphics" program for use in mathematics teaching in the primary school; it is in fact a powerful high-level computing language which has sophisticated list-processing capabilities, and yet is simple and straightforward to use. User adaptation of a simulation-database thus also offers the opportunity to explore a "microworld behind the microworld": the structure and functioning of LOGO as a means of using the computer as a thinking and learning tool. This does not mean that every teacher has to be a programming buff to make any amendment to the package software. In contrast to the arcane formulae of BASIC or assembly language, using LOGO permits understandable alterations to be made at a simple level. Since the simulation-database software is written in LOGO, a school must have access to LOGO to be able to use it. LOGO is however rapidly becoming the programming language of the primary school (particularly since it is now available on the BBC microcomputer), and access to it and familiarity with it will become widespread.

Current Developments

At present, work is well advanced on the construction of two further simulation-database packages: *Palestine in the First Century* (for use in the religious education area) and *The River* (environmental studies/geography/science area). An important element of the project's work is to produce simulation-database packages in a variety of curricular areas.

The main current activity of the project however is to develop a "Do-it-Yourself Kit", a package which will enable any person or group to build their own simulation-database package for use in any curricular area. For example, a small simulation-database might be based on "Our School", and permit movement between the different rooms and areas of the school. "My house" could be a package developed by a group of children. "Our Town" might be a more ambitious project by a group of teachers from different schools, meeting at one school or at a teachers' centre: its use would foster much local studies work, both in and out of school. Other packages could represent countries or regions. However, the simulation-database can be of value in curricular areas other than the environmental: "Inside the atom", or "Journey through the human body" could become the simulation-database packages of the future. Once created, packages may be exchanged, updated, merged or further developed. The range of possibilities is limited only by the imagination and the resources available.

The package-making kit is currently being prepared for the Apple, BBC and Sinclair Spectrum microcomputers. Versions for RML and other computers will follow.

Conclusion

The simulation-database has been evolved as a way of making appropriate use of the computer in the classroom. The computer serves the learning process by storing and processing information. These are activities which it does well; they can, of course, be carried out without a computer, but only with an extremely large amount of difficulty and man-hours consumed. Like other classroom artifacts (think of the piano, the sink or the blackboard), it is used only when its particular attributes are required. It can thus become an effective and a constructive contributor to teaching and to learning.

Note

Enquiries and comments about the work of the project are welcomed. A mailing list is maintained for dissemination of project developments. Further information may be obtained by writing to

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Simulation-Database Project
St. Andrew's College of Education
Bearsden
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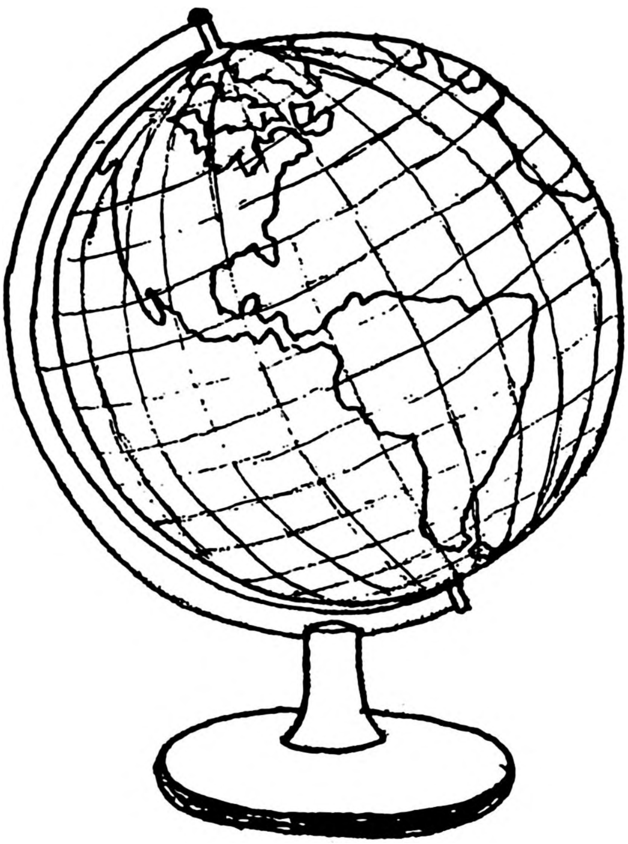
Scotland



Software for World Development Education by Dr. W. Sherratt

Dept. of I.T. Studies, City of London Polytechnic

A group of teachers, computer experts and specialists in development education is in the process of designing a series of computer games in which famine and droughts take the place of space invaders and monsters, and food, medicine and education replace weapons. The team aims to devise computer based teaching materials which will help pupils to understand the major social and economic problems facing countries of the Third World, and the interdependence between Britain and the developing nations of Asia, Africa and South America. The project is directed by the Centre for World Development Education, an independent voluntary organisation.

CWDE was set up in 1977 to improve knowledge and understanding in Britain of the processes and problems of world development. It is registered as a charity, is partly funded by the government, and has close links with the Department of Education and Science and with various United Nations agencies. One of the activities of CWDE is to produce resource materials, both for primary and secondary schools, aimed at encouraging the pupils to make informed moral and critical judgements on various development issues in ways appropriate to their ages, abilities and interests. Because of the increasing use of microcomputers in schools it was decided, in 1982, to investigate the feasibility of producing computer-based development education materials. At the end of that year a volunteer professional adviser was appointed to look into existing resources and the needs in this area. As a result of a series of investigations, discussions, and brain-storming sessions a Computer Materials team was set up. In March of 1984 it held, under the auspices of the National Association of Development Education Centres, a workshop on computers in development education at the City of London Polytechnic.

Useful existing programs

Development education involves learning about different cultures, values, ways of lifes, and interdependence. At the present time there are various computer packages which can be used to support such work. For instance, binary tree packages such as ITMA's "Seek" and Acornsoft's "Tree of Knowledge" are content free programs which can be used to create files for investigating topics like homes, transport or festivals in different countries; Thomas Nelson and Sons "Developing Cities" could be used to develop ideas about urbanisation in the Third World; the Sinclair/Macmillan's "Survival" and Ginn and Company's "Urban Fox" programs could be used to teach about the interdependence of life. Besides developing new programs of its own, the CWDE team is keen to support such material and aims to produce, in consultation with authors and publishers, backup resources for certain of these packages.

Well under way is a resource booklet containing pictures and information on houses around the world, for use with the binary tree programs. After a discussion of the topic the children use the computer program and booklet to create a file on housing. To do this they select two homes from the booklet and formulate a question to distinguish between them. The question must be phrased to give the answer "yes" for one home and "no" for the other. Other homes are then added to the tree, one at a time, by making up other questions to distinguish each of the new homes from one of the previously entered homes, always with a yes/no answer. A good deal of the educational value of such an activity lies in making up the questions with sufficient precision and constructing the tree. When the tree is completed the children may use it in a variety of ways. Other children, for instance, may adopt roles of people living in other countries and deciding on the most suitable type of housing. Alternatively, it could be used as a starting point for classroom activities such as creative writing, art, geography or language comprehension.

Simulation exercises

Perhaps one of the most powerful educational uses of the microcomputer is for simulation exercises. In such exercises a model representing a real situation is set up within the computer and pupils go through a series of role playing activities. For example, a hypothetical third world country might be faced with developing health facilities. Groups or teams of pupils could adopt various roles, be faced with a series of problems, and have to make a range of decisions. How should financial resources be divided between hospital buildings, equipment, drugs and personnel? Should sophisticated hospitals be built in towns or should health centres be set up in villages? How many doctors are needed? How well could a force of trained paramedical health workers cope with the likely demands? Various random events – a drought bringing crop failures and malnutrition, disease striking one area of the country – could be built into the model. During the exercise the computer program could examine the decisions made by the players, taking into account the random events and displaying the consequences of the decisions. The players could then re-examine their strategies and get the computer to show what would have happened if different initial decisions had been taken.

Development education is frequently most effective when pupils can identify with the people and situations being studied, can experience involvement in a situation they are learning about, and can explore through the "what if . . . ?" type of question. This makes simulation exercises particularly appropriate. Moreover, such exercises can have a wider educational value – giving experience in problem solving and decision making, providing practice in communication, developing the skills of consulting reference material, and helping to stimulate deductive reasoning. Simulations, however, are not always easy to set up. Often there is both a paucity of suitable data and an incomplete understanding of the mechanics governing the situation being modelled. If an attempt is made to provide too life-like a model the game may be too complex for the target pupils and too large for the memories of present-day microcomputers. If the model is too simple it may contain inaccuracies and distortions. A good deal of support material must be prepared together with the computer program. The design and testing stages of development are very time-consuming. Nevertheless, at the present time the CWDE team is working on simulations to illustrate the formation of deserts and aspects of life in a third world village.

Data banks

A further type of computer assisted learning uses the computer's ability to store and rapidly process large amounts of data. In development education lessons pupils often have to examine data sources, extract the relevant items and exploit them. For example, a study may be made of a particular Third World country – the homes and life-styles of its people, its religion, its food and agriculture, its raw materials and primary products, its imports, its climate. Pupils may be set a project which requires certain questions to be answered. What type of food is grown in the country? What proportion of the total product is exported? What proportion of the total revenue of the country comes from food exports? What nutritional value is contained in the food? What is the average size of a farm? What proportion of the population is employed in agriculture? How mechanised are the farms? A data bank can be created to store within the computer the answers to these and other such questions and to allow the pupils to input and store their own information. The computer can then handle the purely mechanical and statistical aspects of the work – such as the sorting out of data and the tedious "number-crunching" calculations – and display either in tabular or in graphical form the appropriate results. This would allow the pupils not only to get a speedy interpretation of the statistics but also to concentrate on examining their signficance without the distraction of involved calculations. Furthermore, the data bank could provide starting points for creative writing and other types of project work away from the computer. However, to set up such data banks a considerable amount of detailed research is required to dig out the basic facts. The CWDE team is hoping to produce work along these lines in the not too distant future.

Information about the project

In the initial stages this project was carried out on a voluntary basis and depended on the goodwill of many people and institutions. Recently, however, it has received help from Acorn Computers, who have loaned a BBC microcomputer, and financial support from the Gulbenkian Foundation and Oxfam. Further ideas, expertise and volunteers are always welcome. More information about the project may be obtained from the project coordinator, Patricia Shepheard, CWDE, 128 Buckingham Palace Road, London, SW1W 9SH. In these days of financial stringency a s.a.e with any enquiries would be welcome.

Pipistrelle by Dave Jackson and John Beadsley

"Pipistrelle" is a resource-based simulation program designed to give children of nine upwards the opportunity to experience the nocturnal lifestyle of one of Britain's least known, endangered mammals. The simulation should provide the stimulus for topic work on bats, the environment and conservation of wildlife. This topic would probably occupy half a term. Children have a growing awareness of animals and animal behaviour through direct observations gained from an ever-broadening environmental studies curriculum.

Nocturnal creatures remain outside their experience, but computer simulations provide the stimulation to explore the world of darkness. Obviously any simulation program is a poor substitute for the real thing, being a compromise between the real and the possible, which inevitably offers only a simplistic view of the world.

One night in the life of a bat

"Pipistrelle" is limited to one night in the life of one bat. This night is in late autumn and the object is to attain sufficient weight to enable the bat to survive hibernation – simplistic in the extreme. However, as the children assume the role of a bat, they are faced with a series of problems totally unfamiliar to we humans, eg. the use of sounds to recognise objects and to 'navigate'; where to find food; the importance of weather conditions, etc. Aspects such as these are inbuilt to acquaint children with the links between individual elements of the environment; to develop an aural discrimination and to perceive, select and record events accurately.

The simulation starts with a bat frozen in flight in the night sky. He will always begin by being positioned above the church.

A bat will have a known hunting ground. The first step is for children to uncover features using echo location and to plot these onto their matrices. They should then familiarise themselves with the weather for the night as this affects food supply.

A bat has the ability to 'see' through sound. It is capable of building up a picture of its surroundings based on echoes returning from a signal that it emits.

The bat in the simulation will emit a pulse of sound automatically, each time it moves forward onto a new co-ordinate. This pulse can also be triggered at any time, and as often as you wish, by pressing 'S' for comparison.

Should the square adjacent to the bat's position and in front of it contain either a feature or a type of insect, then an echo will be heard. Each echo is unique to that type of feature or insect.

Developing a strategy for "success"

By comparing sounds, the children will not only be able to uncover the terrain but also find food.

The children are thus forced away from the computer to search through the resource material to familiarise themselves with the unique nature of a bat's existence. Only by doing this can they hope to develop a strategy likely to succeed ("success" being judged in terms of increasing body weight sufficiently to survive hibernation).

The information in the resources is devised to extend childrens' knowledge of bats beyond one pipistrelle on one night. The simulation hopefully arouses sufficient interest to carry the child on to discover an abundance of amazing facts about British bats – what other creature turns somersaults before resting or has a heart capable of ranging between 10 and 700 beats per minute !!

Individual species of bats display different behaviour, eat a variety of foods and have widely varying habitats and activity cycles. Seasonal changes and weather conditions determine the type of food available. The resources contain information on insects abundant in spring and summer as well as those hunted in the simulation. This naturally extends the child's awareness of environmental links and develops an appreciation of the dynamic relationships between bats and their environment.

Relevant information has to be extracted and interpreted to develop a strategy to employ and, therefore, demands far more than a casual glance. Careful investigation, group discussion and decision-making contribute to the development of a regard for taking actions in everyday situations in relation to, rather than in spite of, available evidence.

The information booklets

The 'BATFACTS' booklet contains necessary information on behaviour, habitat and food. From this, the child knows how to hunt and what to hunt for. The 'FOOD-FILE' booklet gives essential information on where and when to find the food. The children then have the information necessary to assess the significance of the environmental features in the simulation and consequently develop a strategy.

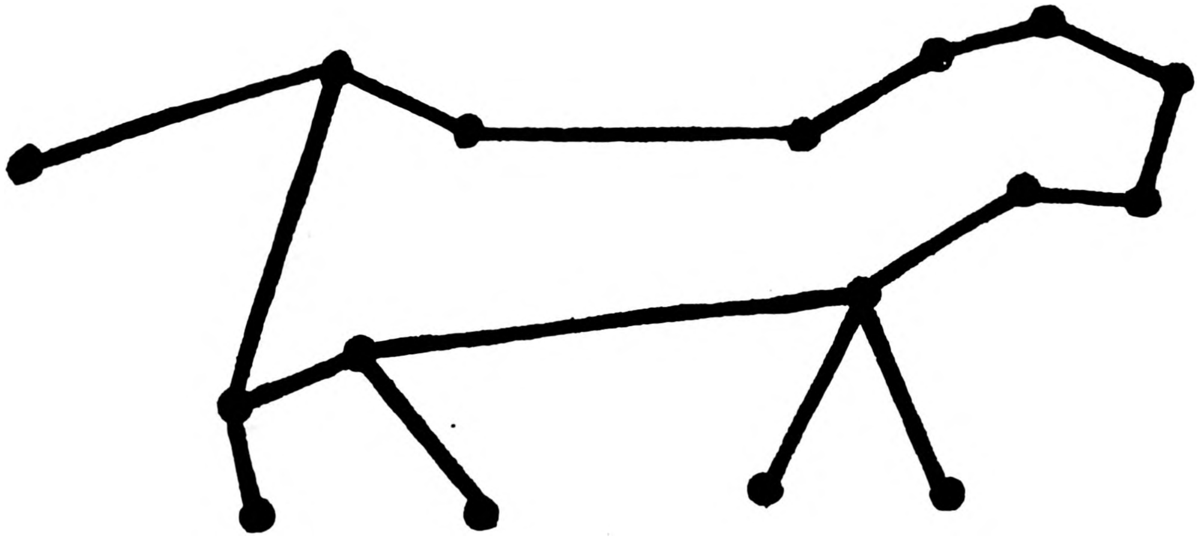
The resources contain suggestions for extension work in other areas of the curriculum, notably science, language, craft and art.

The final stages of development

As we now enter the later stages of development, hopefully only minor refinements will be necessary. 'Pipistrelle' is due for field tests which will help us identify weaknesses and strengths before finalising the package. As the Pipistrelle is capable of eating 3500 insects each night, this is a program destined to have more bugs than most.

NB

Suburban Fox", Dave Jackson's earlier realistic simulation is now available from Ginn and Company Ltd for BBC Acorn (B) disk, RML 480Z disk and cassette, at £30 + VAT, including an extensive resource pack.



Computers: gateway to the stars by Percy Seymour

Principal Lecturer in Astronomy and Director of the William Day Planetarium, Plymouth Polytechnic

This article first appeared in Education, 2 November, 1984, and is reproduced with permission.

In recent months there has been a renewed interest among teachers in the teaching of astronomy. At least some of this can be traced back to programmes on astronomy for schools broadcast by BBC radio and television. Earlier this year some institutions such as planetariums ran seminars for teachers at which they could preview the video tapes of the TV programmes. During discussions with the teachers it became clear that there are many practical difficulties in teaching astronomy during school hours. In this article, I want to suggest several ways of overcoming these problems.

One simple and useful project is to do experiments on shadows cast by the sun at different times of day on several days of the year. This can be used to introduce children to the basic apparent motions of the sun as seen from earth. Another is to help children to construct simple sundials (which can be used during school hours) and simple devices for studying the apparent movements of the stars (which can be used at night, under the supervision of parents). Two recent books along these lines are *Exploring the Heavens with Pupils aged 9-13* by D.V. Clish, and my own book, *Adventures with Astronomy*.

There is really nothing like a visit to a planetarium to arouse children's interest in astronomy. This realistic display of the positions and motions of the stars, planets, moon and sun is the most impressive visual aid to astronomy education yet invented. Unfortunately there are only about 20 planetariums in the UK and their distribution over the country is very uneven. Also the availability of planetarium shows for schools varies greatly from one planetarium to the next.

There are even fewer observatories that are readily available to the public and to schools, and if one wants to look through, rather than at, telescopes the visit has to be made at night. The Royal Greenwich Observatory and the Royal Observatory, Edinburgh offer facilities for showing astronomical equipment to groups of school children, and the Nuffield Radio Astronomy Laboratories at Jodrell Bank run a public concourse building and a planetarium. A visit to a museum, such as the Merseyside County Museum, Liverpool, or the National Maritime Museum, Greenwich, can do much to foster children's interest in space and astronomy. Several of the facilities described above were discussed at this year's annual general meeting of the Association for Astronomy Education (AAE), and it was evident that many areas of Britain were still not within easy reach of these resources.

The introduction of microprocessors into schools has opened up a new range of possibilities for teaching astronomy. Most schools now have access to at least one, and in some cases several reasonably powerful micros, and the static and dynamic graphics possible with these computers can be used to demonstrate important aspects of basic astronomy. An area of particular interest is simulating some of the basic functions of a planetarium.

Several commercially available programmes for popular models of microcomputers are particularly useful when used with secondary school children and undergraduates. However, they have to be used in a rather different way with primary school children. Planetarium experience has shown that the initial impact of the whole sky can be rather overwhelming to young children. It is helpful first to draw their attention to some well-known constellations before going on to talk about the movements of the sky. This suggests that using a microcomputer to plot individual constellations on the screen of the monitor is a good place to start.

Because a single constellation covers a relatively small area of the sky, the distortion introduced by plotting onto a monitor screen what should really be plotted onto the inside surface of a sphere is very slight. There are several ways of showing stars of different brightness. One way is to use dots of different brightness, another is to use characters of different size. If the available micro allows use of colour graphics it is also possible to use colour coding of brightnesses (or magnitudes) just as is done on some star maps.

An alternative way of representing the stars is to use numbers in such a way that if the numbers are linked together in the right sequence the schematic outline of the constellation will become apparent. This method allows greater participation by the children. They could sellotape a sheet of acetate film to the screen of the monitor and with suitable pens could link the stars together, much as a dot-to-dot puzzle is connected. This gives a positive 'feel' for the constellation, and the first method can be used at a later stage when the children can be asked to identify the constellation from the relative positions of the pixels or other suitable characters.

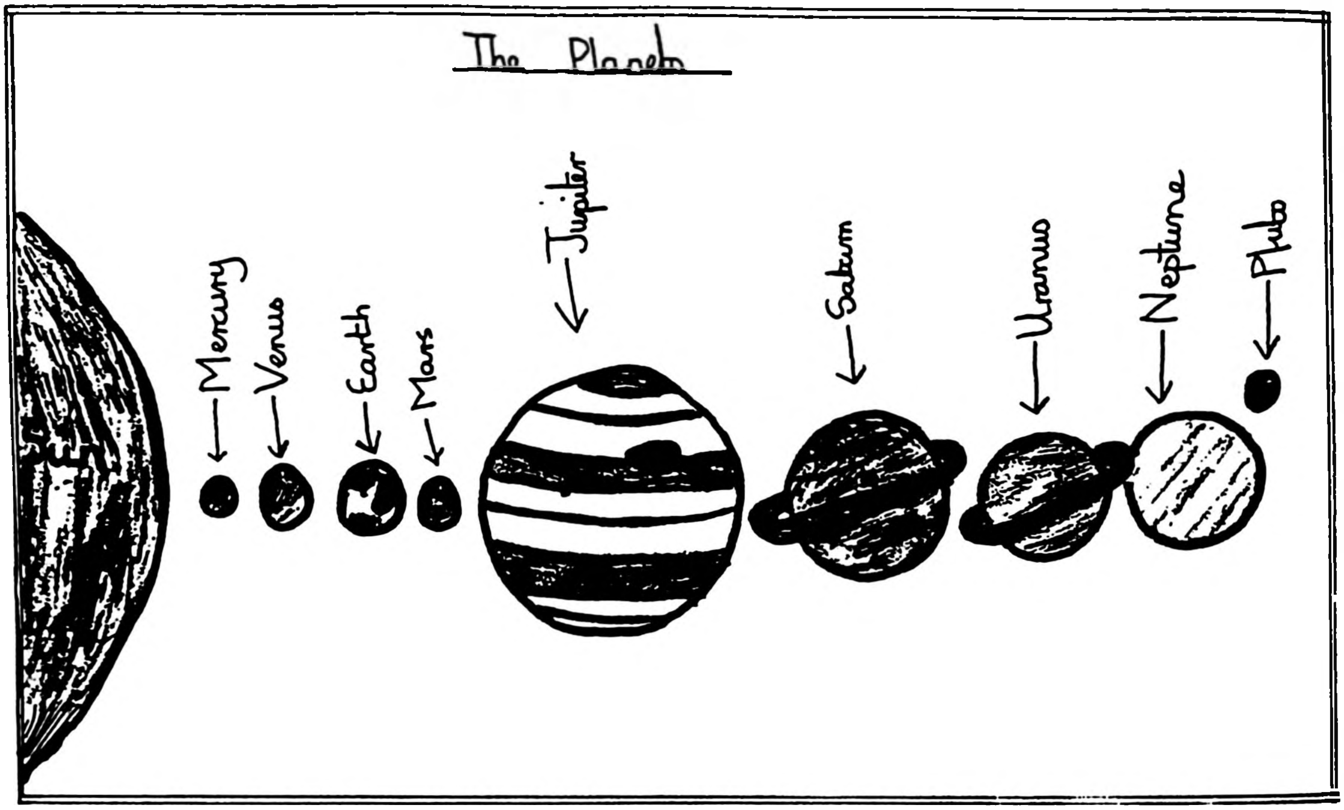
Having identified some of the better known constellations, the next stage is to show some of the motions of the sky. The movement of stars near to the pole star – the so-called circumpolar stars – is the most obvious next step. Some of the programs offering this facility require time and date as input data. When using such a program with children it is best first to fix the date and then consider how the sky will change with time, and second to consider how the sky at a given time – say midnight – will change with date. It is also possible to use the clock or pause facility to drive the circumpolar star pattern around at a predetermined rate.

A program can be started on any chosen date and time, and as it progresses it prints out the date and time at the lower right hand corner of the screen. In most programs each picture is destroyed before the subsequent picture is printed, so children are not made aware of continuous movement of the constellations as they would be in a planetarium. The idea of movement can be consolidated by getting the children to make a nocturnal (or star clock for telling time at night using the Pointers of the Great Bear) and then to check the nocturnal against the computer generated chart of circumpolar stars.

Some of the programs represent the whole of the visible hemisphere as a disc on the monitor, with north usually at the top of the disc. This method of representing the sky is very similar to the method used in the simple planispheres available in many bookshops. The great advantage of the plansphere is that it can be held above the head, face downward: the observer then looks up at it, and the constellations on the device can be readily associated with constellations in the real sky. Unfortunately this is not possible with the monitor screen, and some children experience difficulties when going from the vertical screen to the sky above.

With such children it is more convenient to use a program which shows the sky in the form of two semi-circles representing the two halves of the visible hemisphere – one looking south and one looking north. Although, as in a planetarium, most micro simulations also offer the facility to show the sky from different latitudes, most children find this particular concept difficult and it is best left to a later stage.

The accessibility of micro-computers has thus brought several important advantages of a planetarium within easy reach of most classrooms. Children have an interest in micros, and most children show a keen interest in space and astronomy even if much of this stems from space fiction. By using micros to teach astronomy two natural interests are combined. Furthermore, the simulations of the night sky offered by micros look more like the reality being copied, than any other simulation except that of a planetarium.



Project Exodus by Ian Coulson

Dep. Primary Head, Manchester

In essence, Project Exodus is a space adventure topic for junior children which uses four short computer programs to act as a catalyst for stimulating learning. The class I was teaching at the time was a mixed ability fourth year. The school was situated on a large council estate called Wythenshawe.

A colleague and I were discussing several possibilities we had for 'action topics' when the idea came to simulate the eventual destruction of the earth. This would be due to pollution and high radiation. This is how the 'package' was presented to my class.

Day 1 A letter was sent to each member of the class (I used the banda machine to duplicate). It began "LETTER TO ALL INVOLVED – FROM COMMANDER C

Dear Friends

You have been selected to work on Project Exodus. There are four groups of you altogether. I hope at least one group will survive and land safely on an inhabitable planet.

If you do not work quickly and sensibly however you will still be on the earth when the Gamma count reaches 500 – death level. You will have all the materials you need and the money required to buy them. Anything you ask for, you may have. I only wish I was coming with you, but the journey is only for young people . . .'

The letter ended with a threat to crew members that insufficient team work would result in him or her being sent to the laser chamber (the head's room?).

This letter was followed by their mission instructions which were to work closely with the group in order to

1) Design and build a spaceship
2) Select a planet or moon to colonise
3) Collect and store a) equipment needed for the journey b) evidence of Life on Earth
4) Be ready to depart in 6 weeks.

Conveniently, the school runs a 'house competition' comprising four teams, named after British birds. Therefore the class split into these four groups in project lessons and became the four crews. A little role play and group dynamics developed when each crew assigned a job for each member – captain, navigator, provisions officer, craft designer etc . . .

Everyone was required to keep a log of each day's activities e.g. logdate 23.1.2085.

The first task for each group was to make a planet search of our solar system and possibly other star systems and decide which planet to attempt to colonize. A variety of resources were used for this including the local library and the BBC TV Zig Zag programme.

Identification papers were made (using a banda machine) and throughout the project I gave the children weekly progress reports and task sheets. On each progress report was the current gamma count which decreased as the weeks went by.

The introduction of Program 1

At this point the computer first played a part with program one. Each of the programs began with a short identification sequence and a pass word (crew name) was required. In program one, potential space pilots had to guide a craft through a 'scrolling' universe of stars and planets. Collision with a star ended the test but successful pilots were those who amassed 200+ points (the points total increased as time progressed). Successful pilots collected one of three MASTERWORDS (Titan) and a SPACE PILOT'S LICENCE (again a banda).

The intention was that the first three computer programs would give MASTERWORDS needed to feed into the fourth program – the program which blasted the children into space.

A second task was to design and build the spacecraft for the crew's journey. This was done over a period of time using wood, cardboard, nails and odds and ends, and of course, the spacecraft were imaginatively painted. In the end, the four spacecraft were quite large and hung 'in flight' from the classroom ceiling amongst the collection of stars (polyhedra made and painted in art lessons).

Program 2

The second computer program was a SPACE INTELLIGENCE TEST. The 10 questions for this were based on their research into the planets. When all ten questions were answered correctly, the second MASTERWORD (Mimas) was given.

The Planet Search and Spacecraft design were now called FACTFILE 1 and FACTFILE 2, and a further four FACTFILES were made on these topics, FACTFILE 3 – The Moon. FACTFILE 4 – The Stars, FACTFILE 5 – scientific research, FACTFILE 6 – earth data. Many science experiments on air, flight, water etc, were done which made up FACTFILE 5.

Program 3

The third computer program was a simple angle estimation exercise whereby the children had to turn the barrel of a laser gun through the correct number of degrees in order to fire at a randomly positioned star. After a certain number of 'strikes' the third MASTERWORD (DIONE) was obtained.

The final program

The final computer program was a simulation of a rocket or shuttle launch in which a countdown sequence was followed by blast off. This program was 'chained' into the final display and through the monitor (the spacecraft's window) a view of the planets evolved.

I didn't really say which crew had survived but I did comment on the thoroughness of each crew's preparations and research.

The project itself lasted around a term and other curriculum work naturally evolved along the way in terms of drama, creative, imaginative writing, art work, maths (estimation of fuel required after weighing the crew, spacecraft and contents). But more signficantly I enjoyed watching the interaction of social and language skills in which each crew member actually did make a useful and valuable contribution to the mission.

Having now experienced several 'action' projects using the computer for simulations and information processing, I have always found that the appeal of this approach to learning is very great and very often the 'middle of the road' children find areas within the project in which they can 'shine'.

In Project Exodus a boy called Michael, who had earlier given his parents concern over his reading and writing, produced three Exodus folders crammed full of a variety of research work, much of which was done in his 'own time'.

Presently the class I am teaching is concluding a project based on Ginn's "Mary Rose" program. Again, I packaged the project in a similar way to Exodus. This time there were 'diving' crews and again 'middle of the road' children have shone. One girl in particular called April took the project to heart and the understanding and work she has produced is remarkable.

No sophisticated programming skills were needed to put together the four Exodus programs. The introductory sequence was the same for each program and this was 'CHAINED' into the other parts of the programs. Similar programs could be found in many of the computer magazines available at newsagents for a variety of topics, I just happened to use one theme of space. And I do believe that the packaging of the project is all important. This approach makes learning fun for the children, enjoyable for me and invariably ensures a happy, lively and trouble-free classroom.

A Hint of What is to Come
An Introduction to Microwriting
by Julie High

Benton Park Primary School, Newcastle Upon Tyne

"Don't look out of the window, she'll make you write about it." We've all heard that joke.

Children don't really see why they should write, and if we're not careful it can become a chore.

Handwriting is a skill not easily acquired by all, it's a skill requiring good hand and eye coordination, fine manipulative ability as well as reading skills. It is a lot to ask if a child is still struggling, and not difficult to understand why concentration and motivation lessen.

What a lovely experience I shared with my class of top infants in the last term of the year.

We were asked to work with a small word processor, with keys for the fingers of one hand, a Microwriter.

I had a lovely class with 25 children and a wide range of ability. None of us had any experience of computers. In fact I felt slightly threatened by this new presence in the classroom. Mr Peter Wheeler (M.E.P. and C.A.I.S.) supplied us with three office machines, a B.B.C. B computer and a set of 4 linked up Microwriters which plugged into the computer.

Microwriter is an alternative to the ordinary typewriter keyboard which was something none of us had heard of before. However, it did not take us long to come to terms with it. We were asked to play, not to use charts, and told that we had about six weeks in which to learn. This presented problems in organising my classroom and keeping a check on the children's discoveries.

The whole thing was quite revolutionary in our school. Parents arrived, looking anxious and begged to know what on earth we were doing! Who better to share the experience? Their enthusiasm quickly matched mine. Grandparents and parents from other classes became involved too.

As the children played, their reactions were noted on a simple record sheet alongside the time spent and right or left handedness. They each built up a special relationship with the Microwriter and told the adults how to use it. Interaction and responses were very pleasing. Confidence and concentration seemed to grow as the joy of discovery reinforced learning and motivated the children to go on.

How quickly they found out how to key in letters, words and sentences, and how interesting it was to watch the different routes they took to their discoveries.

The boys found E.T. and U.S.A. as well as some daring things which they would not have dared to write in their story books. They knew how to delete anything bold before it was read by m. Thn th coman ky cam itoit? soown. What power! I love Jemma. DELETE!

The girls mostly were more correct, writing names, alphabet, Mum etc. I could not see a particular overall aptitude in either boys or girls.

It was a girl who discovered all the commands and the alphabet after one hour and forty minutes, but it was a boy who appeared for school very early and who was determined to find out how all this microtechnology worked. Very soon he set up the computer and made ready a game for the children when they came in.

A definite aptitude for keyboard skill was apparent in some unexpected areas, it was lovely to see a sense of relief in children who found handwriting difficult. In fact I began to see how frustrated some must have been, having ideas to express but having this barrier to overcome.

Some children needed to use finger charts after a while, and this surprised me, they were determined to translate dots to finger patterns and they could remember. I began to wonder whether I had some budding pianists here. They had such aptitude for playing chords.

I learnt things about some children I would not have otherwise have realised.

Touch typing was cunningly taught in an arcade type game called SKRAM (after the nine year old, Mark, who invented it). Four children shared the computer and keyed in letters as they appeared in the Space Invaders type game. After a while there was a shriek, "I can do the alphabet with my eyes closed!" Never have I seen such excitement and yet there were few instances of naughtiness. They seemed so completely satisfied that I felt I was seeing a glimpse into a future when keyboard skills were taken for granted, when perhaps handwriting would be a thing of the past, even postage as we know it now.

Next came a variety of games which were much enjoyed, followed by a programme called QUAD. This enabled four children to share the screen, each writing his or her work on the microwriter, and being able to "scroll" to read the text. Soon some of them used the existing commands and discussed their work together. There came an awareness of punctuation which was quite unusual. Perhaps this was because it had the same status as letters on the microwriter.

Being corrected by friends appeared to be more readily accepted than even the mildest criticism from me.

Best of all was the sight of this work miraculously appearing in print, the speed of the printer seemed like magic. Ideas came thick and fast, and were quickly taken up by M.E.P. and passed on. The children felt quite impressed that their ideas were valued in the modifications of programmes etc. Suggestions flowed, a school magazine, we could write books, (I would not have to type them anymore!) letters to be sent home could be printed.

The children approached this whole experiment without fear or inhibition, they were used to reading text from a screen, whilst I found it tiring. I have to admit that I had problems, there was technical failure to cope with, inadequate knowledge on my part, even burning the midnight oil did not seem to help. Until I realised that this was just a teaching resource and fallible at that. I felt like throwing it out of the window sometimes. Gone my plans and strategies, readiness for my class!

However this meant that a different relationship with my class materialised. We discussed everything, they advised me, perhaps they saw my human failings, and enjoyed helping, it was a challenge to all of us.

One or two parents were uneasy, and were not convinced that children were benefiting because it was so completely new to them, but doubts were dispelled by what came next. I became worried in case the children would not want to go back to writing in their writing books, but how rewarding it was for all of us to see the motivation this short experience had given them.

An average of six hours had been spent by each child. I considered how often I had needed to remind some individuals of what they should do before! Because of the support I had enjoyed from parents not much time had been diverted from other areas of the curriculum areas. Microwriting had reinforced reading and writing skills, encouraged many who had been disheartened, and on the whole extended concentration spans across the class.

I couldn't stop them writing!

I'm sure that some success must have been due to the involvement of parents, the extra time spent on my part, and the particular class and situation, but I'm also sure that most of the success was due to Microwriter.

I wouldn't have missed this experience for anything.

NB
Details about cost and supply of Microwriter and Quinkeys (linked-up keyboards for sharing VDU) can be obtained from Microwriter Ltd, 31 Southampton Row, London WC1

Word Processing and the Craft of writing by Peter Heaney

Londonderry Teachers' Centre

"Writing is a craft; a craft is a process of shaping material towards an end." D. Graves.

This is a report of a case study carried out in a primary school with children from two classes, primary six and primary seven. The specific aspect investigated was the use of a word processor (EDWORD) and the possible role it might have in the development of written language. Since the time scale for this study is short; only three months, no conclusions may be drawn, however observations can be made and indications outlined.

Although the main concern of the study was the children's own written language, inevitably the children's reading skills were vitally important and the study considered whether a development in the child's written skill, either conceptual or technical, would have a correlated effect on their reading skill.

The dominant idea of the study was to examine the effect that the editing and reviewing facilities of the word processor as a writing tool would have in the hands of children. Particular attention was paid to the development of the children's written text through their drafts of the document. At every stage they were encouraged to discuss what they had produced and amend it if necessary. The role of the teacher here was one of facilitator rather than intervenor.

The sample and method

The children were drawn from two primary classes in groups of three initially, to use the word processor, later this was changed to allow the children to use it on an individual basis. These were mixed ability groupings, the children being selected after consultation with the teacher. The children were introduced to the word processor at a plenary session which was initiated by a discussion of their own writing and the problems that they had. These included poor handwriting, lack of ideas, inability to change their work without having to rewrite it, grammar and punctuation errors etc.

Some text, generated by the children's ideas, was entered on to the screen and they were invited through discussion to edit it. At no stage were the children told that there were errors to correct in the text. This was to discourage the children from seeing it as a spelling and punctuation error spotting exercise; rather the lead was taken from Seymour Papert in his book MINDSTORMS who views the computer (word processor in this case) not as a teaching instrument but as a tool which will allow the child to explore writing as a 'real' writer and reach an awareness of the significance and purpose of writing through the insight gained from this experience. Consequently an attempt was made to use the computer to desensitize errors ie. texts were to be debugged and 'bugs' could be found in content, grammar or punctuation. The children were encouraged to view their work as a progression through a series of drafts where their written ideas could be expanded or edited to suit the context of their initial thought. Discussion among the group about the text and the ideas to be communicated was encouraged as a tool to reach a sharper awareness of what they wanted to say.

The relationship between language and thought

The ability and language skills of the children involved dictated the progress of the exercise, but it was hoped that each child would reach an awareness of the relationship between language and thought, and the role of language in communication and as a vehicle for thought. On this point of the relationship between language and thinking Vigotsky believes that

'The instrument makes possible the product, the product refines the instrument.'

An attempt was made to give the children an experience of the personal satisfaction of writing rather than it simply being another skill which school demands. Bullock was taken as a theme,

'In our view the main stream of activity in the area of personal writing should arise from a continually changing context, not from a prepared stimulus. The context will be created from the corporate enterprises of the classroom and the individual interests and experiences of the children' Bullock.

The children were encouraged to decide on their own topics, what they wanted to write and indeed if they wanted to write. No coercion was used. This it was felt would have inhibited the development of the writing process by seemingly contradicting the spontaniety of intention; and transferred the motivation for the task to the teacher, making it more difficult for the child to identify with the piece of work as his/her own from conception through to completion. An assumption was made here that the word processor of itself would motivate the children to want to use it, subsequently arriving at a stage with the motivation shifting from a position of the children wanting to use the technology to write, to a position of wanting to write using the technology as a tool to facilitate their own writing. The format of the study involved the children initially in groups and then individually entering their text on to the screen. These sessions were of necessity short, only a half hour, because only two machines were available. The children then discussed their text with the teacher, and what they had wanted to say and the relationship between the result and the intent.

Developing a sense of confidence

The major problem here was a lack of confidence by the child in the teacher's intention. The children wanted to measure their 'composition' in terms of the teacher's approval. Unfortunately a neutral response or question from the teacher (teacher in this context refers to the author) was interpreted as disapproval and constituted the motivation for editing the text. A lot of time was spent developing a sense of confidence in the child that the criteria for judging the work was, how well it matched what the child wanted to say. This was a process of moving from an interpretation of writing as an exercise in linguistic logic with a perfect model, set up, corrected, and monitored by the teacher; to an idea that writing was a form, albeit sometimes very inadequate, for representing and communicating thought and feeling; with the final right of editing belonging to the author.

"To grow towards competence, it is of paramount importance that the writer comes to see the writing act as purposeful behaviour." School's Council Working Paper 59. Talking Writing and Learning 8-13. This paper goes on to outline two important conditions to achieve this competence:

i/The writing should represent genuine communication ie. it should be seriously received by the reader.

ii/It should enable the writer to know more about himself.

It was important that the children understood and accepted these conditions as they were vital to creating an atmosphere where they felt secure that their writing would be accepted as a process of developing a written articulation of their thoughts and would not be measured against an external criteria of grammar and punctuation, applied by the teacher; nor would they be expected to write about artificially contrived subjects or situations.

"We are not trying to achieve good work but facilitate defining the articulation by freely manipulating the code." School's Council Working Paper 59.

Once the children appreciated that this was the situation, they became more relaxed and eager to show their work to the other groups and explain the thought behind the written articulation. However it was some time before this stage was reached.

The use of groups enabled this development to be viewed from a different perspective. Informal attention to their discussion patterns revealed an eagerness on their part to spot each others grammatical and spelling errors. Each child typed in a few sentences and then they got down to the business of tidying it up. As Donald Graves in his book 'Writing', succintly explains this procedure, they tried to

"Put a good manicure on the corpse."

The children had accepted the popular understanding of revision, as looking for spelling, punctuation and hand writing errors, but not examining the content of their work in any great detail. Teacher intervention in the work here directed attention through questioning, to the content of the text. The children were encouraged to question each other and explain what ideas they were trying to express. They compared their thoughts with what they had written and then tried to shape the text, through this type of interaction, to a better expression of their thought.

Each child or group of children had two formal timetabled sessions each week with the word processor. There were two word processors available for their use. They were then free to use at least one of these on an informal basis if they had some free time during the remainder of the week.

After each session with the word processor the children obtained a printed copy of their work for that session. Sometimes this was only a few lines, but they were encouraged to take this away from the session and use it as a basis for further thought and discussion before their next session, to help stimulate the development of the written articulation of their ideas. As Vigotsky points out,

"The evolution from the draft to the final copy reflects our mental process." Vigotsky 1962.

Again this type of interaction took time to develop and initially was quite disjointed and unproductive. However, gradually the children began to be better able to focus these management and interactive skills on their writing both individual and group through the process of using a word processor.

The physical ability of the word processor to allow the children to edit text easily and with a printer produce fair copy every time would seem to facilitate that development of written language which would concentrate on the content of the text rather than the grammar. Bullock draws attention to this development of written language:

"In much of the writing that takes place in school the pupil's first attempt is expected to be the finished article; there is not enough encouragement of the idea of a first draft to be followed by a second, more refined production."

"The teacher who aims to extend the pupil's power as a writer must therefore work first upon his intentions, and then upon the techniques appropriate to them."

Margaret Donaldson takes this argument further in her book 'Children's Minds', and suggests that to gain control of and an ability to direct a process a child must be conscious of it. She further suggests that written language, both reading and writing offers this opportunity for reflection with associated general development in cognitive awareness. Since the written word is tangible and enduring it exists as a permanent record of an attempt at articulation and can act as a reminder or a prompt to revise, rework or rethink. It is this process of rethinking which brings into the child's consciousness the purpose of language and it's relation to his own thought process; thus becoming aware of his own thinking as a prelude to gaining control over it and being able to direct it.

"Thus it turns out that those very features of the written word which encourage awareness of language may also encourage awareness of one's own thinking and be relevant to the development of intellectual self-control, with incalculable consequences for the development of the kinds of thinking which are characteristic of logic, mathematics and the sciences." Donaldson 1978.

This notion is also found in Seymour Papert's book 'Mindstorms,' where he realises the potential of the computer as a versatile tool for the children to explore this process of cognitive development and awareness.

"I believe that the computer as a writing instrument offers children an opportunity to become more like adults, indeed like advanced professionals, in their relationships to their intellectual products and to themselves."

The role of the word processor in this development is central:

i It places the child in control of this process of cognitive awareness. It's editing facilities allow easy revision, freeing the child from initial considerations of spelling, grammar and handwriting errors, which add to the tedium of having to physically rewrite second and subsequent drafts.

ii Those editing facilities also permit the child to analyse the content of the text and consider it's adequacy in conveying his thought.

iii With a printer it allows the child to accumulate fair copies of his creations which when held in anthologies are a personal record of his work.

The evidence indicates that the micro computer and word processor will have a very important role to play in the development of children's cognitive awareness and its illustration in their language, both written and spoken; this, because the computer places control into the child's hands allowing them to explore their world and reach a consciousness and thus control of their thinking process.

"Written language demands conscious work because it's relationship to inner speech is different from that of oral speech: the latter precedes inner speech and presupposes its existence (the act of writing implying a translation from inner speech)... The change from maximally compact inner speech to maximally detailed written speech requires what might be called deliberate semantics – deliberate structuring of the web of meaning." Vigotsky 1962

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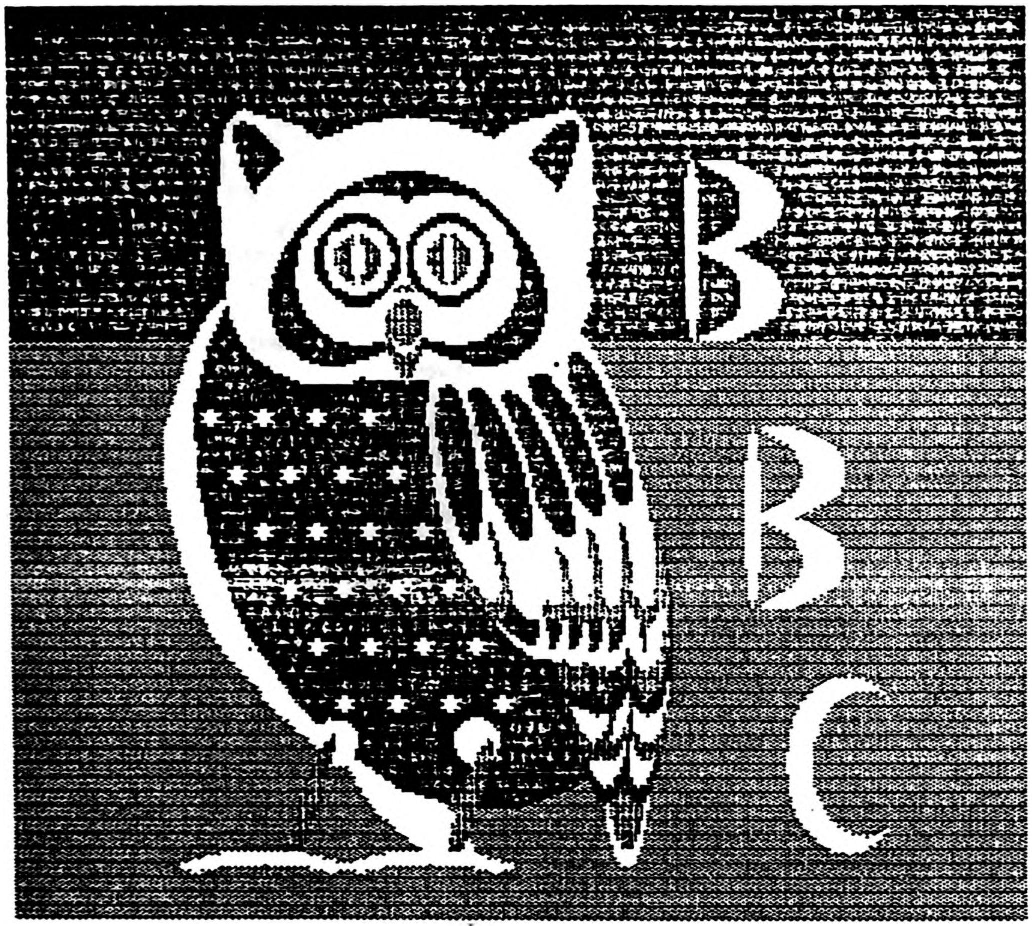

Wordwise with Juniors? by Allan Clamp

Headteacher, Wild Bank C.P. Stalybridge

Waxing lyrical at interview (always a bad idea!) about the potential of using word processors with Primary children I saw that look of horror on the face of the Primary Adviser followed by a glazed expression. That was two years ago and I have seen the look repeated in different contexts. Computers – yes, great, but what you do with them is a different matter! (Advisers like headteachers are good at generalities). It has often been said that there are four main uses of computers in the Primary Classroom (a) low-level programs (most of the MEP pack for example) (b) simulations and problem solving programs that upset caretakers because kids are in school early and late working to solve them (c) LOGO versions with or without turtles, buggies or little green men and (d) word processing. The dedicated word processors (how many thousand £'s ?) are, of course, out of the question for Primary Schools (and the vast majority of other institutions). Word processors for us are ordinary micro-computers with either a special program (on cassette or disc) or a special ROM chip fitted. My brief and frustrating flirtation with cassette based programs resulting almost inevitably in cassette loading problems coupled with a long and frustrating delay in loading even in optimum conditions led me, swiftly, to look for something better. The only real alternative on the market at the time was the ROM (a chip fitted literally in minutes) based WORDWISE (Computer Concepts 1982) and then came the VIEW ROM (Acornsoft). It was not until over a year later that EDWORD ROM (Clwyd CET +MEP funding 1983) came on the market. So it was with WORDWISE that I started together with a b/w portable TV and cassette recorder.

Why use a word processor with Primary children anyway?

I have always believed that the use of any apparatus or equipment must serve the aims and philosophy of the school. It should also reach the objectives set out in the most economical way. That sounds self-evident but who can put his or her hand on heart and swear that they have always done it as far as the computer is concerned. The modern Primary classroom is not the easiest place to work in!

The use of Occam's razor is necessary every so often. We must cut through woolly thinking and assess band-wagons. Is the computer being used when traditional methods are more effective? The computer is such a valuable asset it should not be wasted eg used on tasks that can be done as well or better in different ways.

There are a number of writing activities that are perennial problems. At first my thoughts were not defined. There were a number of problems. Getting reluctant writers to produce anything worthwhile (no value judgements intended) is always a struggle. Children who have great problems in reading back their own writing yet can read the same words from the printed page. Evolving strategies for correcting and re-presenting work are difficult. To get across the idea that the work should be improved (impossible!). Teaching the strategy of planning, executing, correcting and arranging work incorporates a number of useful skills, allowing able children to follow a piece of work through and present the end product in a book or newspaper rather than be content with the acceptable minimum.

Why WORDWISE?

I bought WORDWISE in 1982 and used it extensively for work connected with school. I found it excellent for producing discussion documents for staff meetings. Producing a few copies of long documents which needed changing before final agreement presents a problem in a small school with secretarial help at a premium. Dinner money and various returns seem always to get in the way. WORDWISE was useful in producing a brochure of all the computer programs in school with a copy for each member of staff. All the many books on the banded reading scheme have been put 'on' WORDWISE and printed out with a copy on tape so that it can be easily updated. For example we are on the third copy of the Computer Programs.

To be honest I thought that a disc-based system would be out of the question in a small and poor Primary school. So the big plus with WORDWISE was the fact that it was ROM based. Those who have struggled to load long programs from tape after the BREAK key has been pressed will appreciate this point. Type *WORDWISE and be ready to go. The system used a tape recorder to store the "SAVED" documents and this itself was a plus as it kept it cheap.

How to start?

I brought my own machine into school on the one morning that the secretary wasn't in and used her desk in the entrance 'hall' to put on the computer, b/w portable tv, cassette recorder, printer and miles of wire! (a trolley is a much better idea). I find it easy to introduce new ideas into our open plan informal school and it certainly is quicker to spread news. "When's it our turn", is the usual problem. I chose the top Junior class to start work with WORDWISE. The normal class mixed ability groups were used with a leader chosen in case of dispute. I sat in at the first session with each group largely to reassure children. The fact that the 'page' doesn't need to be formatted is important. The minimum of instruction was given and members of the group were encouraged to help each other, especially at first, to find the right keys. Each member had to contribute a sentence to the group story as an introduction and they had to type it in themselves. Less able children were deliberately chosen in some groups as leaders so that the group could produce 'J's' story. Intense interest was aroused amongst other groups to read what had been written and a great deal of appreciation with very little negative criticism.

The second stage was to introduce the editing facility. The first wonder (after the magic DELETE that was shown initially) was the OVERWRITE facility. To be used carefully as they soon realised! The rest of the red function keys were mastered to some extent except the convoluted embedded printer command instructions and those were only used under my instructions with the numbers copied in at the right places. The apparent complexity of the embedded commands didn't worry me unduly as I realised that this facility would be replaced in other w.p. developments.

Evaluation?

At the moment I am not using my WORDWISE in school. We, in common with a few other Tameside schools, are assessing EDWORD. We have been loaned a computer, monitor, 100k disc drive and Epson RX80 F/T printer for a six month trial. After less than a third of this period I can say that there are two definite advantages of EDWORD over WORDWISE. The first is that no embedded commands are needed. Centering, underlining, justifying and formatting are very easy for children (to say nothing of adults). The other advantage is the almost instantaneous recording on disc. The biggest disadvantage is the positioning of the "COMMAND" key next to the BREAK key. If the BREAK key is pressed before the document has been saved then it is lost. I have done this twice whilst producing this article and whilst the language produced may be expressive its not the extension that our children need!

WORDWISE has its advantages in the ease of skipping in and out of edit mode, the use of markers in the text makes deletion or movement of passages of text very easy and the word counter is fascinating to children and useful to adults. The biggest advantage is the ability to use the O.S. commands whilst in WORDWISE and having acquired a PRINTMASTER ROM this makes life very interesting for adults but it's probably too sophisticated for children (famous last words!).

So should I buy WORDWISE

I'm afraid the answer is a bit "iffy"! If you have a disc drive with the computer that you are going to use as a word processor I feel that EDWORD is superior. WORDWISE can be used with both cassette and disc storage systems. I feel strongly that if you have that second computer you ought to think seriously of devoting it exclusively to w.p. as a serious educational use. Yes, I have tried it with middle infants, and yes, they can get a lot out of it and yes, it needs someone to keep an eye on things and yes, the head could do this occasionally. If you are building up your system on the cheap ie buying a basic BBC machine without DFS and using b/w TV I would go for WORDWISE. I am glad I bought my WORDWISE and feel that I have had my money's worth. As with the computer world in general things change so fast in word processing. There is a definite niche in the market for a manual geared to Primary School children and their busy non-specialist teachers for word processors. The "Guidelines for Primary Teachers" produced by the manufacturers of EDWORD is definitely not the answer! It needs simplifying and extending. What of the future? When I was asked to write this article I contacted the makers of w.p ROMS for an update on their products. The makers of EDWORD were the only firm to respond and have material for the Primary School.

Postscript

'State of the Art'

The reason for the lack of information from Computer Concepts has become apparent with the announcement (TES 7/12/84) of the "WORDWISE PLUS". Thus the 'state of the art' changes with the advantage once more with "WORDWISE". EDWORD PLUS is a disc based 'update' but it is far from easy to use. The introduction of the segment concept means that for writing cloze procedures the original text and successive partially-deleted versions can all be stored on segments.

"Wordwise Plus" costs £49 plus VAT. "Wordwise" upgrades are available direct from Computer Concepts only by returning the complete "Wordwise" package at £17 plus VAT. Computer Concepts, Gaddesden Place, Hemel Hempstead, Herts.

"Edword" User Pack £38.95 Primary Guide £10 (cassette) £12 (disc). Teacher Pack (£21.95 cassette or £24.95 disc). Clwyd Technics, Unit 4, Antelope Industrial Estate, Rhydymwyn, Mold. Tel: 0352 83751

Introducing Edword: Word Processing in the Primary School

by S.R. Osborne and U. Daniels,

Tameside LEA

This article is written with the intention of continuing the debate on the introduction of microcomputers into primary school classrooms. It explores the way in which word processing facilities can be used to help pupils develop their writing skills and thereby increase their confidence in the written word. The second part of the article gives examples, drawn from the experiences of some Tameside primary schools, of how the introduction has been received by teachers and pupils. But firstly it seems essential to cast these experiences into a wider context.

In discussions with teachers it has become clear that they see the microcomputer in the classroom as having two major roles. The first is concerned with the aims and objectives the school has whether the micro were there or not. Every good school attempts through its curricular structures to define what it is about and the methods and experiences which will be presented as a vehicle for these intentions. The micro, through its speed and capabilities, can help teachers realise and develop these objectives by enhancing opportunity and allowing freedom to explore ideas and concepts which would otherwise be difficult to attain.

Secondly, the arrival of the microchip in many everyday activities, has altered the perception and purposes behind curricular issues, often in fundamental ways, as it has done with the nature of the society in which we live. The curriculum of schools should 'budge over a little' to accommodate these changes.

The word processing capabilities of micros fall into both these roles. The article explores their use as an aid to writing.

Aside from intuitive signals which pass between persons when they are communicating, there are two formal ways in which we pass on to others our thoughts and feelings: speaking and writing. Writing is therefore an extremely important activity, but there are many who would wish that they were much more competent and confident in their own capabilities of writing.

Writing is a complex activity. There is the content of what is to be written, often lodged in the mind of the writer, but not easy to pull out; the mechanics of letter formation, word construction (including spelling), legibility (including writing in straight lines), punctuation and writing style (calligraphy). Add to these, presentation and purpose and the case is made.

In many classrooms, pupils receive much negative feedback on their written work. There is the relative slowness of writing in comparison to thinking, the hand can get out of step with the head; there can be a lack of neatness in the presentation; the final produced piece of work does not do justice to the intentions of the writer. These are personal rebuffs, but others may come from the teacher intent upon an evaluation and feedback to the pupil of the work completed.

What do teachers do with writing? Do they praise the content and ignore other aspects or do they make corrections on the page? It may also be the case that the teacher's appraisal of the work is affected by its presentation and the pupils may receive other signs of discouragement than those they have received from their own evaluation.

Purposes of writing

In the Bullock report, 'A language for life', Section 11.8 contains '. . . We believe that progress in writing throughout the school years should be marked by an increasing differentiation in the kinds of writing a pupil can successfully tackle . . . '

Others have worked on lists of such kinds of writing[1] e.g. i) self-expression ii) personal and fictional narrative iii) poetry iv) plays v) information vi) and other purposes like diaries, personal letters, formal letters, persuasive writing, lists, note making, instructions, plans and rough drafts, reviews and evaluations and notes for personal use.

These are the purposes behind children's writing. Who is to read it, matters. Next comes the content, its structure and form and only after this does the writing occur. In the process, such factors as spelling, punctuation, re-shaping and presentation all take their place.

[1] A Writing Checklist for 5-12 year olds. Language and Literacy Diploma Group – Brighton Polytechnic 1983/84

What do word processors do?

The important question now, therefore, is what do word processors do and how can they help in the above processes?

A word processing facility, when loaded into use on the microcomputer, will allow a child to type in letters and spaces. The memory then holds them and the internal working of the machine controls them. What is written appears on the screen and what is shown on the screen can be printed onto paper through an attached printer. Copies of the work can be stored by the computer for future use by pupil, teacher or both.

Pupils at any time can make corrections to the writing e.g. modify spelling, interchange upper and lower case letters, insert words, change punctuation and even alter the way they want the work to be presented. They can wait until they are quite satisfied with what appears on the screen before having it committed to paper.

In this extremely important way, the word processor justifies itself. Pupil errors are not end points in a learning process, but are points for discussion and the beginnings of correction strategies. In this way much of the negative feedback of traditional writing can be turned into positive encouragement of pupils. In the end it may take more time and effort, but the final product can be as good for all pupils as the best effort of the best pupils.

Finally another dimension can be introduced to pupils' writing which, as we all recognise, is a solitary activity. Writing as a communal activity becomes possible. Several pupils can put their creative minds to a piece of work and work together, sharing and discussing ideas. In this way a greater contribution can be made to the language development of those pupils involved.

The Edword project

In September 1984 five schools were provided with a complete word processing package i.e. BBC computer with Edword ROM, monitor, disc drive and printer. These would be on loan for a period of six months so that teachers would have a reasonable length of time in which to assess the value of word processing in their schools. The schools were selected first and foremost because a member of staff was interested in word processing but an attempt also was made to include schools with a range of backgrounds.

Edword was chosen in preference to any other word processing package because it was thought that it would be easier for primary school children to use. With only two exceptions where control codes are necessary, what appears on the screen appears also as hard copy so that centering, underlining, indenting etc can all be seen on the screen. The commands are very mnemonic e.g. Command key and T to go to the top of the document, Command key and M to move a section of text. If an error occurs, such as trying to move past the bottom of the document, a beep gives a warning and by pressing the Error Help key a child can discover what is wrong. These and other facilities make Edword much simpler to use than other systems on the market.

The teachers involved in the project were given a demonstration of what Edword would do but as far as introducing it into the classroom was concerned, they were left to incorporate it into their teaching in their own way. This was to avoid the possibility of everyone following the same set pattern, to allow it to reflect different teaching styles and also so that different approaches could be considered. By chance all schools initially introduced Edword to either Junior 3 or 4 classes but some were planning to experiment with its use lower down the school. Only one school chose to use the 40 character option, the others finding 80 characters satisfactory.

What happened in the classrooms

All the teachers decided to show the children what Edword would do either as a class or in small groups, but without going into very much technical detail. It seemed to be felt that the children should be allowed to start using the computer to create a piece of work and then gradually introduce the editing facilities as they were needed. For the first piece of work, some teachers asked children to write a story or a poem or to describe themselves. Others sent a child or a group of children to the computer whenever the class as a whole was tackling a piece of writing in any subject area. This meant that each child/group used the computer for different types of writing.

Contrary to the expectations of some teachers, children found Edword very easy to use in the initial stages. Prior to introducing Edword, one school did some preparatory work in General English on the use of capital letters, sentence and paragraph construction, critical appraisal and self-correction. But provided that they know how to produce capital and lower case letters, where the cursor keys are and how to delete, children are able to make a start. At this stage they are not necessarily using the facilities to the best advantage but they are getting the feel of using the computer for creative writing. Occasional assistance is needed and this was catered for in several ways – some teachers encouraged children to help each other, one school produced a card of the most useful commands and another allowed children to use the handbooks.

In this way, the first stage was not at all teacher intensive. However, when it came to revising their work, more help was required in order to learn, for example, how to insert words, how to delete whole words or sentences and how to alter the sequence of sentences. One school was planning to produce some exercises to help children acquire these editing skills before making use of them in their own writing.

How the children used the word processor

The length of time that children spent at the computer seems to have been considerable – e.g. "up to an hour" and "one to two hours". One comment was "longer than using other methods", but when I compared what a child was producing on the screen with what other children were producing in their books, there did not seem to be a vast difference in quantity.

In most cases it appeared that their typing could keep pace with their train of thought, although one child tended to miss out words in his first draft because he was thinking faster than he could type and one group of children did comment that they found the slowness of typing to be their biggest problem. However, even if the initial draft does take longer, time is saved at the revision stage since the whole piece of work does not have to be re-written and many drafts can easily be produced.

In the early stages, most of the correction and revision seems to have been done on the screen before printing, although some teachers from the start took a copy of the first draft as soon as it was completed. The children then made their corrections on the print out. Using this method means more economical use of the computer time since it is being used for creating or actual revising rather than thinking out corrections, but to do this successfully it is advisable to use double spacing for the print out. It means however that if a group is working on a piece of writing a large proportion of the discussion can take place away from the screen.

The benefits as seen by the teachers

After half a term of use, the majority of teachers were still very enthusiastic. One school claimed that Edword had created more interest in the computer than all the programs previously used. Among the benefits listed quite independently by different teachers were:

1. The length of writing increased. More work was produced. On revising, the children all voluntarily extended their work a skill not normally practised.
2. Children concentrated for far longer, becoming completely asborbed in their work. One teacher commented on the fact that word processing is not distracting to other children nearby.

3. Punctuation seemed to improve e.g. in one school the children of their own accord introduced speech marks into their writing.

4. Critical skills and self-correction developed as they became keen to improve their work. Initially there is a tendency for children to look for the more obvious spelling and punctuation mistakes. Some may need encouragement to actually look at the content of their writing, their choice of vocabulary and their sequencing.

5. The children became eager to write. They particularly appreciated the wordwrap facility and the ease of deleting whole words and phrases. Minor errors that they made while creating a document did not necessarily slow down the process – "Never mind, you can change that later." One child who was virtually a non-writer produced some work in his book after being helped to type a few sentences and receive a print out.

6. One school felt that because of the ease of moving lines around and altering the order of large sections, better poems were produced.

7. The children were tremendously satisfied on seeing the printed copy since even for a child with poor handwriting, his copy was as neat as anybody else's. Being able to make copies very easily meant that extra copies could be printed to be taken home, to put on the wall or to be kept by the teacher.

The benefits of using Edword seemed by far to outweigh the disadvantages. Pupils and teachers alike are finding the time needed quite justified in relation to the value they see coming from the experience. In some cases, pupils need know very little of the operating mechanics to be able to benefit.

Problems

The main problem mentioned by all teachers was the close proximity of the Break key and the Command key. If the Break key was hit by mistake, the document was lost and this seemed to have occurred on at least one occasion in each school. Other problems seemed to be of a minor or temporary nature caused by lack of familiarity with Edword. For instance, children would delete several words in order to go back and correct a mistake not realising that they could use the cursor. There was some confusion over positioning the cursor to insert or delete and because they were typing they seemed to make more errors than they would have done if they had been writing by hand. Even though these difficulties were fairly minor, they were aggravated by the time that a child had to wait before using Edword again. Despite having a computer dedicated to word processing, the length of time needed by each child meant that there could be a gap of several weeks before they could use it again and to use it effectively a child must reach a certain level of proficiency.

Questions about future use

Our experience during this term indicates that word processing has a great deal to offer in the primary school. It has enormous potential but also raises a number of questions that are as yet unanswered. How much "tuition" should children be given in the technicalities of using this type of program in order to get the best possible use out of it without causing confusion?

How long should they spend at the computer and how much revision should take place away from the computer? To what extent should they draft out the work beforehand or will a few notes suffice? There is a danger that Edword could be used in order to get a printed copy of a piece of writing that is already completed, in which case it becomes no more than a typing exercise and the real value is lost.

The word processing facilities by themselves can do little for pupils' work, but by allowing pupils to concentrate on a few facets of their writing at a time and then synthesise the whole at their own discretion, they encourage the pupils to make a greater personal contribution to learning. Teachers, however, will still have to encourage pupils in their own handwriting skills, but hopefully with increased enthusiasm gained via the word processor.

Wordprocessors and written language in the primary classroom by Judith Baskerville

The article that follows is based on more than a year's experience, including work in schools, as a research assistant for the research project "An investigation into the use of the wordprocessor in the development of children's written language" at Humberside College of Higher Education, under Project Directors, David Bowen and John Hurst.

In the primary sector it is only in the last two years that the microcomputer as a wordprocessor has been considered and used in the classroom. The instances are not many but they are growing. Many people who are still coming to terms with the micro in their classroom may well ask, "Why should I use a wordprocessor with primary children?". The answer is partly contained in the statement below and partly in looking at what we are trying to teach children when we teach writing.

> "If you make a mistake you just have to press delete and no one can see the awful mistakes you've made."
>
> Christian, 8yrs 7months.

What is this child's attitude to writing? I am not for the moment concerned with his attitude to writing at the wordprocessor but rather with what this statement tells us about his attitude towards the writing process in general. It would appear that this youngster's approach to the writing process in the normal classroom situation is adversely affected by the number of mistakes he expects to make. Whatever initial enthusiasm he may have for writing is systematically undermined by the need he perceives for accuracy and correctness to the extent that he focusses on those first. How can wordprocessors help such a child, or any child, to develop his strategies for writing so that he moves away from a concern about grammar and syntax to an awareness also of the mutability of text and the possibility for insertion and alteration?

Writing (not handwriting, which is a different skill) is a complex and difficult task for many adults. Some never truly master the art of written communication, possibly for the very same reasons that are implicit in Christian's statement above. For many children in the primary school, writing can be a task which requires them not only to put their ideas down on paper but to make sure they make the minimum of mistakes. How many children write very little, the bare minimum necessary to satisfy the teacher, because they know that to get a fair copy they are going to write it all out again correcting their mistakes? If all we are concerned with is the form then fine, but what about the quality of the content? Some of the ideas contained in a child's oral language work may be good and his written work might well improve if he were able to discuss ideas, change his mind and alter what he had written with ease. This is the essence of developing the child as a writer. Developing in him the ability and perception to see that first ideas may not always be best, but that you can always change them, add something in or reorder. For many children, even if we give them the opportunity, this is something they would rather not consider, because to practise and develop such an approach means constant writing and rewriting of a piece of work.

The benefits of word processing

This is where the wordprocessor comes in. If children are allowed to use a wordprocessor for some part of their written work, then they have the opportunity to use a tool which will allow them to focus on text created on screen, to add, insert, delete, correct, and finally to have a perfect (or as near perfect as they can make it) final version of their piece of work. This process would have required several total rewrites if done in the usual manner. Perhaps the greatest benefit is that which we have found in the course of our work in schools during our first year's research into the role of the wordprocessor in the primary classroom. We allowed children to work in groups of three and found that, in providing them with the opportunity to collaborate and create a piece of text as a group, they were also provided with the opportunity to discuss their ideas, write them down and then rework the piece easily if they so wished. It soon became apparent that what this allowed also was an opportunity for the children to begin to see for themselves, through discussion, that when you write something down you often need to put it into a different form than that used when talking about it. Any transcript of speech, even between adults, is a collection of half finished phrases, side tracks and unfinished ideas. This is because when we are speaking we also use intonation, gesture, facial expression and attitude to enhance what we are saying. The written form lacks all of these, yet for children to develop as writers they need to be able to develop an understanding of these differences, as well as of what written forms they can use. To do this requires that they be given the opportunity for discussion, redrafting and refining of ideas. We have found that the motivation to go on and rework pieces is increased when the wordprocessor is used, for it allows them to do this with ease and flexibility. To do this with pencil and paper all the time may create in many children the sort of attitude which say's "that's enough 'cause I'll only have to rewrite it".

Children are also learning to write (handwriting this time) and are practising their handwriting during the primary years, and the need for a neat copy, a readable copy, may well hinder those children who are not yet perfect handwriters. For these children, the knowledge that with the wordprocessor their piece, however long or short, is going to look as good as anyone else's is often a big boost. One remedial reader and writer with whom we worked last year was highly motivated to read what his group had created on screen. In addition since the work created on screen, as well as the finished product, is closer to print than handwriting, he was also able to see some of the quality of their work without the smokescreen thrown up by handwriting ability, or lack of it. First impressions are very important and it may be the case that some children's written language ability is underestimated because of their poor writing and spelling.

An additional benefit is that use of the wordprocessor encourages the children to read through and check their own work to see what changes they may wish to make. These may be alterations in spelling, punctuation or grammar as well as alterations and insertions to the form and content to improve the quality of the text as a whole. In doing this they know that the changes needed can be made easily and this encourages them to spot inconsistencies in their story and bits they have missed out as well as allowing them to change their minds completely. Only by doing this will they develop the internalised self-checking techniques which will ultimately help minimise the overall changes needed as they compose or create a piece of prose. The ability to spot one's mistakes and ommisions does not appear overnight and the wordprocessor is a marvellous medium for encouraging children to see their text as mutable rather than fixed and so develop this ability through practice.

The practicalities of use

The practicalities of using the wordprocessor in the primary school are regarded by some as a real problem. "How can I use it when I have thirty in my class and only one machine"? The answer is that like any other use of the micro it does require thought and planning. It also requires a mental move on the part of the teacher away from the idea of the child as a lonely writer all the time. Children need to be able to write on their own, but in addition they could be allowed time to work in groups (we have found groups of three to be the most suitable) and in a collaborative manner produce a piece of text. Once the groups have got used to working in this manner they can produce some interesting pieces of work without disrupting the rest of the class and with positive effects on each individual child's writing in the normal classroom situation.

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Some examples of work

The following are some examples of work completed by a group of eight year olds working for thirty-five minute sessions at the wordprocessor. The work was carried out in an open-plan classroom with the normal class activities going on all around. All the examples involved the group in the kind of writing tasks that most children encounter at some time in their school work.

1) Story, using a Picasso picture 'The Tragedy' as stimulus

First draft:

One day a long time ago a man said to his wife "I think it is such a lovely day we should all go out in the boat for a while". They called their son in and set off in their small

sailing boat. After a while they came across a big ship, then all of a sudden they heard someone scream. "I wonder what that was about" said the man to his wife. They sailed to the big ship, when they got on the big ship they forgot to tie their small sailing boat up. They looked around, after a while they found someone tied to a chair with a bomb next to them. They quickly untied her.
Second draft:

The disaster at sea.

One day a long time ago a man said to his wife "I think it is such a lovely day we should all go out in the boat for a while". They called their son in and set off in their small sailing boat. After a while they came across a big ship, then all of a sudden they heard someone scream. "I wonder what that was about" said the man to his wife. They sailed to the big ship, when they got on the big ship they forgot to tie their small sailing boat up. They looked around, after a while they found someone tied to a chair with a bomb next to them. They quickly untied her, then ran to the deck. The man said "you can come on our boat". Then they realized that they had forgotten to tie their boat up. They ran back to the room where the bomb was, they looked at the timer, there was only five seconds left. There was a blast and the boat blew up. The girl died in the blast. The family found a wardrobe door and jumped on it and floated to a nearby island. They jumped off the door, onto the island. They kept seeing ships in the distance, they waved at them but it was no use, none of the ships saw them. So they stayed on the island, cold and hungry, until they died.

****

2) Factual information: A set of instructions on how to ride a bike, to accompany a bike being sent to an Eskimo.

First draft:
How to ride a bicycle
(1) First put the bike down with the round things on the snow, these are called wheels.
(2) Then get hold of the long things that stick out, which are called handlebars.
(3) Then sit on the triangular thing (sit facing the handlebars) the triangular thing is called a seat.
(4) Put one foot on one side and one on the other making sure that your legs aren't crossed.

Final version:
How to ride a bicycle
(1) First put the bike down with the round things on the snow, these are called wheels.
(2) Then get hold of the long things that stick out, which are called handlebars.
(3) Put one foot on one side and one on the other making sure that your legs aren't crossed.
(4) Then sit on the triangular thing (sit facing the handlebars) the triangular thing is called a seat.
(5) Now put one of your feet on one of the rectangular things that are near the middle of the bicycle these are called peddles.
(6) Push forward with your foot (the one which is on the peddle).
(7) As you push with your foot put your other foot on the other peddle and push forward with your feet (one at a time).
(8) Now turn the way you want to go. If you turn them left you will go left and if you turn them right you will go right.

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3) Book report, children's own choice of task.
First draft:

Charlotte's Web

Mrs Arable went to see Dr Dorian about Fern. She said Fern was spending most of her time at the Zuckerman's farm playing with the animals. Since the writing had appeared in the web, lots of people had come to see this fantastic pig called Wilber. Fern told her mother that the animals could speak. Dr Dorian said the animals might be able to speak but he had never heard one himself. Dr Dorian said "When she gets older she will be more interested in boys than animals." Dr Dorian asked if Fern knew any boys. Mrs Arable said Fern know Henry Fussy. Dr Dorian sat thinking about Henry Fussy.

Final version:

Charlotte's Web

Mrs Arable went to see Dr Dorian about Fern. She said Fern was spending most of her time at the Zuckerman's farm playing with the animals. Since Charlotte the spider had woven the writing in the web, lots of people had come to see this fantastic pig called Wilber. Fern told her mother that the animals could speak. Dr Dorian said the animals might be able to speak but he had never heard one himself. Dr Dorian said "When she gets older she will be more interested in boys than animals." Dr Dorian asked if Fern knew any boys. Mrs Arable said "Fern knows Henry Fussy". Dr Dorian sat thinking about Henry Fussy. Then Dr Dorian said "There is nothing to worry about". Soon the day of the show came, Mr Zuckerman took Wilber to take part in the show which was to choose the best pig, but Wilber did not win.

We like Charlotte's Web because it shows that animals might be able to talk. The animals are the main part of this story.

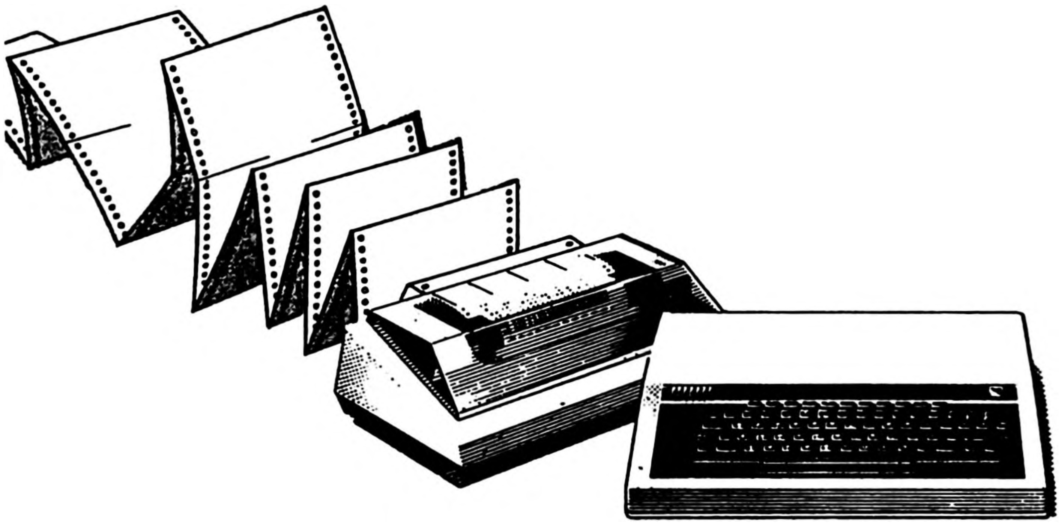
****

4) Another group of children gave the following reasons for liking to use the wordprocessor for writing.
(1) We like the computer because it is easier to use on rubbing out mistakes and you don't have to delete everything.
(2) We like the computer to write stories on.
(3) The letters are to write with instead of writing with a pencil.
(4) If they did not have any letters on we would get stuck and not be able to know where any of the letters are.
(5) When you do something wrong you can go back to it and correct it.
(6) If you miss something out you can go back and put it in.

****

What then is indicated by these pieces of work? In the first piece, when the children were becoming familar with the wordprocessor, they adopted a purely sequential approach to extending their writing. However, as their confidence in the tool they had available grew, they began to look into their writing and add, insert and move within the body of text they had created as well as adding to the end of it. This is a move towards an awareness of the mutability of the piece they are creating. They are becoming writers and communicating rather than just being producers of a piece of work for the teacher. They are able to use to advantage a valuable and useful tool to extend, in a meaninfgul and non-frustrating manner, their developing abilities as writers. They begin to focus on developing the quality of the content and they begin to develop an awareness of the differences between the spoken and the written word through group interaction and talk.

Surely by introducing the use of the wordprocessor in some writing activities teachers are adding to and enhancing their usual approaches to written language development and materially benefiting their children's learning.



Our introduction to text handling with third year juniors by Pat Fox

This article first appeared in Primary Swift, No4, S.W. MEP, and is reproduced with permission

Like many primary teachers, I have watched demonstrations of various wordprocessing systems and seen possible applications in primary schools but the capital outlay is considerable and I am not sure justifiable at a time when financial constraints are so harsh. Consequently when I was asked to run a trial on 'Telebook', which promised at least some of the benefits of a wordprocessing system at a fraction of the cost. I was pleased to agree.

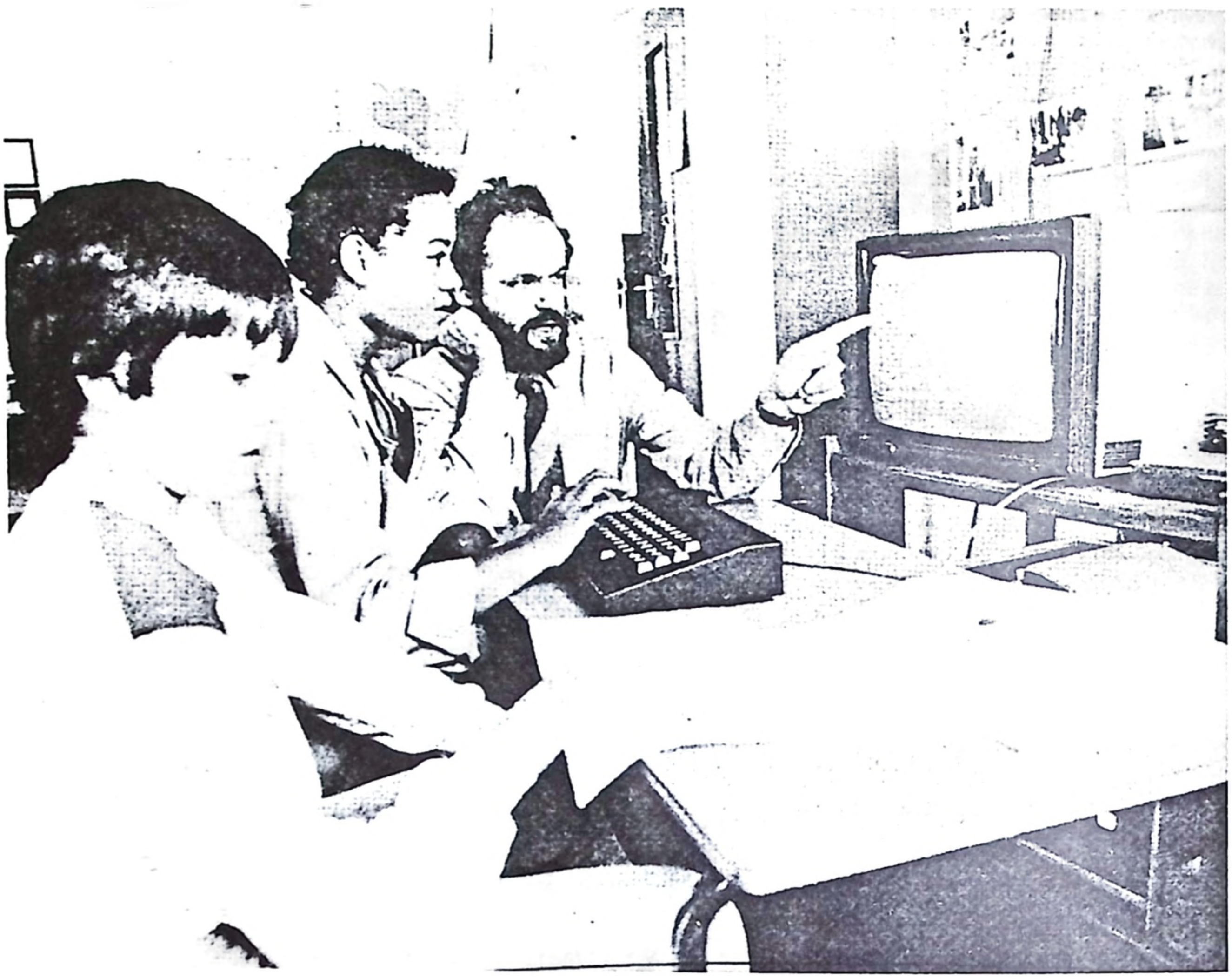
'Telebook' is a program which enables both children and teachers to use the computer to record information, stories, poetry etc; to enhance their work with colour and simple graphics and to store their work on disc or cartridge as a 'telebook'. At any subsequent time, the 'book' can be retrieved and the various pages may be viewed, edited, re-arranged, copied or cleared.

Initially, I used the program with a class of third year junior children and we wrote a class magazine. The children worked in pairs and the choice of subject matter and format was left to their discretion. At the beginning, the children needed quite a bit of assistance. This was partly due to the fact that our early copy of the program had a few 'bugs' in it but mostly because the children were not used to having such a range of facilities available nor were they used to having to make so many decisions for themselves. In their early enthusiasm, they were too ambitious and tried to achieve advanced graphics which were beyond their own and the program's capabilities but eventually, they became more realistic and devoted more space to the text.

Later, I used 'Telebook' as part of an Infant/Junior language project. As part of a general language scheme, the junior children produced a reading book for a specific infant child, taking particular care with the selection of the subject matter, language, size of sentence etc. When the book was completed, it was read and criticised by the infant and then it formed the basis of further language work. Many of the infant children wrote 'follow-up' stories and these were corrected by the junior children and put on to a 'telebook' for other children to read. (To increase the infant's awareness of a sentence as a unit of meaning, the junior children typed each sentence in a different colour). The 'telebooks' were very popular and motivated even the least able children.

Like the majority of 4MATion Software, 'Telebook' demands quite a high degree of teacher 'input' and lack of time and other commitments prevented me from exploring the full potential of this program but it's possibilities are many, particularly in project work. Some ideas are included in the manual provided with the program e.g. the use of telebook as a set of workcards or information sheets, the use of telebook as a catalogue or a log book and the use of telebook for the exchange of information in the form of a newsletter or electronic mail.

Of the various programs I have used in the classroom, 'Telebook' ranks as possibly the most functional because of its versatility and range of application. It places the computer in its rightful place in our classrooms i.e. as a resource that can enhance the learning process and provide another medium for the transfer of information and the expression of ideas. This medium is attractive to the children because the finished product is so appealing and unblemished and it is attractive to the teacher because it motivates the children and encourages them to be concise and well organised in the planning and completion of their work.



Composing and transcribing in children's writing: The effects of using a word-processor

Alistair Ross

Fox Primary School

This article first appeared in Language Matters, No 1 & 2, 1984 (ILEA), and is reproduced with permission

In my classroom I try and arrange that children write for a real purpose: we write in class to record important things that have happened, ideas and opinions; we write to entertain and inform; and we write to reflect and sort out our own ideas and feelings. Most of our writing is written to be read by an audience (although, of course, some writing is private).

So we publish. We make class books, one-off magazines and books. Donald Graves writes of children as authors: 'writing is a public act, meant to be shared with many audiences . . . Publishing (children's writing) contributes to the sense of audience' (1983, p.54). Becoming an author – which is much more than becoming a writer – means that 'children change from imposing their own understandings of process and content upon authors, to realising various authors can use process and content differently' (Graves & Hansen, 1983, p.182).

This article is about how some older primary school children have used a word-processor program on the school's computer to help in developing their writing skills. At school we have an RML 380Z computer, which is similar to the machine that most ILEA primary schools are standardising on (the RML 480Z), and the TXED program for word processing, which was developed by Research Machines and used under licence in ILEA.

A word-processor is more than a glorified typewriter. Briefly, the user has a typewriter-like keyboard, but the characters typed appear initially on the screen of a monitor. By pressing combinations of control keys, words, letters, paragraphs can be juggled about to change the order. New text can be inserted, old text deleted. The text on the screen shows the part of the total text being worked on - the earlier part (and the later part, if one is editing the middle bit of a text) is hidden off the screen, but can be recalled instantly. Texts can be 'saved' on a floppy disk or on tape, and called up again at a later date. When a printed copy is needed, the text can be output to a printer. Various instructions can be placed in the text that are not to be printed, but are instructions about how the final printed copy is to be laid out ("formatted") – the length of the lines, when a new paragraph is needed, if a space is to be left, and so on.

To give an example of what this looks like, here are two examples of a text, first as it appears on the screen, and then as it appears when printed:

.1150
.ce
Cowboy Tom
.pp
'Money or your life!'
.pp
'Money. You can't do this!'
.pp
Bang! Bang!
.pp
'He's dead. Quick, get the money and
scram!'
.pp
The horses galloped over the cobble
stones. Cowboy Tom looked out of the
window. 'It's Murder Bill!' he shouted.

Cowboy Tom

'Money or your life!'

'Money. You can't do this!'

Bang! Bang!

'He's dead. Quick, get the money and scram!'

The horses galloped over the cobble stones. Cowboy Tom looked out of the window. 'It's Murder Bill!' he shouted.

It will be seen that lines that start with a stop — . — and are followed by a pair of letters give instructions to the printer, and are not themselves printed. Thus:
.sp means 'leave a space'
.ce means 'centre the next line', and
.pp means 'start a new paragraph'.

The writer has thus got a much greater power over the text they are creating than is conventionally the case, and this has important implications for the act of writing itself.

Frank Smith (1982) separates this act of writing into two parts: that of composition and that of transcription. The two are distinct yet intimately related: the composer (the author) is concerned with ideas, grammar, the selection of words and phrases; while the transcriber (the secretary) has the physical effort of writing, of making it legible, with correct spelling, punctuation, layout, etc. The two functions are often performed by the same person, simultaneously (I am now sitting at the keyboard, coping with both problems at the same time), and this is the way that most children write creatively. But, as Smith points out, 'composition and transcription can interfere with each other' (p.21).

My first approach to the word processor was thus to use it to separate the two processes of writing, in particular to help three third year children whose transcription problems were impairing their ability to compose.

The class were writing novels. Hard-backed sewn-binding novels, with flyleaves, end-papers, frontispieces and all the paraphenalia of real books, and all of them made by the children. Most of the books were substantial – some were 5000 words long and this sustained piece of writing stretched over many weeks. They researched stories, made notes on characters and locations, devised maps to make sure that the plot fitted together, worked up opening paragraphs. Some of the bilingual children in the class made double-length books, with parallel texts in their mother tongue and in English. But three members of the class gave me cause for concern. I was sure that they could create a sustained narrative, but problems of handwriting, spelling, layout and puntuation were such that they soon became dispirited with their efforts.

One solution would be to type their drafts for them as they wrote each section. But while this would encourage them in their efforts, it wouldn't do a lot to help them overcome their problems. Their problem (and that of many other children) was not merely one of requiring legibility in the final copy, but needing legibility in the draft copies as well. Letting the children type drafts themselves is only a partial solution – not only is there a limit to the numbers of layers of Tippex that can be applied to a single piece of paper, but there are more fundamental constraints on the interaction between composition and transcription. As Smith puts it: "The typewriter suffers from spatial and temporal disadvantages . . . A typewriter is just too mechanical in forcing the writer to compose in the direction the machine is designed to operate, from left to right across lines and from top to bottom down the page. It is not easy while the paper is in the machine to erase and insert, and particularly to put in marks that cannot be made with the machine, like an arrow down the side of the page ...... Erasure and insertion are important and pervasive parts of writing."

The word processor allowed any number of drafts to be made and easily ammended: only the parts to be changed needed to be re-typed. For this project, each of the three children typed in their own text from their initial rough version, and we then corrected this together. After each section had been entered for the first time, we sat down and went through it, I moved the cursor around the text as a pointer to prompt (sometimes) their own correction.

The child would then go on to type in the next section of the story: and then this too would be corrected. The act of using the word processor seems to have partly focussed attention on some of the common problems of transcription. The example below is of a child who had difficulty in punctuating his work: the sheer physical problems of manipulating his pen would not allow him to concentrate on the, to him, relatively trivial problems of which case to use, sentence and paragraph markings. Here is part of one of his first attempts to type his story:

No I havent seen the wolf but i heard a noise it was the wolf howling.

Thank you for telling me this bye.

The use of the paragraph symbol (.pp) had been mastered by this stage. I helped him to correct the draft, and he then went on to type in the second section of the chapter.

Sam went to the church when he got he was there were guards.

Can I see the vicor?'

the gaurd said this was please.'

The vicor said yes what is it?'

This mant waants to see you sir.'

Some improvements are evident: these were built on as this section was corrected. That this concentration on these transcription errors was worthwhile is shown on the child's next effort at typing in the next section. Without the effort of having to concentrate on a pen, more attention is given to the transcription.

Afterwards they went back to the castle. 'what's going on here?' said tom then lord wolf came.

'why don't you join in its good fun.

'no thank you we have to go to bed.'

Lord Wolf was talking to the new mayor.

'How does it feel to be the new mayor' said Lord

Wolf. The New mayor was called sir Ivan.

sir Ivan said 'it feels wonderful.'

With my next class, this time of fourth year juniors (not the same children as before), I tried to see if the use of a word processor would influence the act of composition as well as the act of transcription. The project was to produce a class magazine, duplicating the text after it had been formatted on the word processor. The magazine, called FOXFIRE!, was to be produced as a co-operative venture, the children themselves raising the necessary capital (about 40 pence each) and sharing in the rewards when the magazine was produced for sale.

Each child was to produce a short story for the first issue. Most of them produced a rough draft in a notebook first, but I encouraged them to produce the copy on the word processor as soon as possible, and to then play around with this draft until they were satisfied. For example, one poor writer produced the following first draft:

A man was walking along the rode when he saw a fling space ship it was a ufo it was very brihty. He codnot beliv his eyes, about 2 milas away from his house, the space chipe was very big with blow dots on it, and it was flat tow macham got out of it they were very smol about 3 foof long they had no her and very big eys they had 4 legs and 9 eyars but they were friendly. I liket them a lote I whent in side the Explord he gave me a prasant I gave him one. and then I went home.

We talked about both the problems of spelling and punctuation in the piece, and also about the general style of the piece. Who was the narrator of the piece? What was it to be called? The writer first checked out some of the transcription errors, and then began to modify the text. Finally I went through it again with him. The final published version was as follows:

The Unidentified Flying Spaceship

I was walking along the road when I saw the flying space ship. It was a ufo. It was very bright. I couldn't believe my eyes. I was about 2 miles from my house.

The space ship was very big, with blue dots on it. It was flat. Two martians got out of it. They were very small – about three feet long. They had no hair and very big eyes. They had four legs and nine ears, but were friendly.

I liked them a lot. I went inside and explored. They gave me a present, and I gave them one. Then I went home.

However, it would seem that this may be a longer term objective: composing at the keyboard will take longer to learn than transcribing. Nevertheless, I would expect most children of this age to learn to compose in this way, with practice, within a year or so. On a personal note, I used to write anything I wanted typed in longhand first, and then type it out when I was satisfied with the draft: I knew from experience that I couldn't compose at the typewriter keyboard. When I came to the word processor, about a year ago, I followed the same pattern, typing in from manuscript draft, using the formatting commands to create the effect I desired. It was only after several months that I began to compose at the keyboard – typing in first an outline, then headings, and then working each of these into a more substantial text. I am now convinced that these are necessary skills for children to master, and, if the hardware and software is available, to master at a relatively early age. There are currently advertisements in the popular press advertising the death of the pencil – Microwriters are pocket-sized word processor attachments. Large corporations are working on the processes that will accurately transcribe and format speech into typewritten form. There seems every likelihood that these processes will become cheap and commonplace over the next few decades.

Most children, as this one, seemed reluctant to juggle their text around much. This was probably partly because the word processor was new, and there are a fairly large number of commands to master to move the cursor around the text, to move, copy and delete text. Most of their effort at this stage was going into mastering the transcription (formatting) commands. I think that this may

change. But they were also probably inhibited from a desire to change their texts by their assumption (often imposed on child writers, but rarely on adult writers) that the text must be right first time. Because transcription with young writers is so slow, the idea of re-working and polishing a piece of text (other than perhaps a poem), means an enormous amount of time and frustration is expended in the rewriting. The word-processor should make all this much easier.

This will not mean the death of writing. But it will mean that teachers will have to carefully redefine which skills are the essential ones for the child to learn in order to become a writer.

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Logo with Infants by Marilyn Metz.

I became a teacher-member of the Chiltern LOGO Project in September 1983, a year after Richard Noss had started the project in the Chiltern MEP region. I joined six junior teachers who had been using Apple LOGO for a year with Apple II computers and Edinburgh floor turtles. I was then teaching top infants who had no school-based computer experience. Our brief was very broad: to investigate the use of LOGO within our classrooms.

Having spent some time during the summer holiday becoming familiar with LOGO myself, my concern was the practical one of organising LOGO within my own classroom. I needed to arrange things so that the children's use of the computer fitted in with my general teaching style and our classroom practice. I wanted the children to work in small groups to encourage discussion and cooperation. I also wanted to minimise my intervention, so that the children could explore LOGO in their own ways and so that they could handle the daily management of the computer as independently as possible.

Organising for Logo

With these things in mind, I grouped the children in threes, each group having a file on disk, identified by a filename they had chosen. The children were then able to load and save their files as they worked. Their filenames were found on cards, with the group members' names, numbered and kept in a box. When a card came to the front of the box, it would be 'turtling time' and when the group finished, the card was returned to the back of the box. I used these cards to record when the group used the computer, and through the year the children used them to record their own information. I knew that some of the class would have difficulty remembering the commands, and so I made cards with illustrated LOGO commands on them, which were kept with the computer. As more LOGO primitives were needed, so more cards were added to the collection.

Aware of the need to create a sound framework, I introduced LOGO to the children before the hardware came into the classroom. I told the class that we would be using a computer and a computer language called LOGO, which they could use to control a floor turtle and make it draw for them. I explained that there were a lot of words in the language called LOGO, but that they would only need to know about four of the words at the beginning. These words were FORWARD, BACK, LEFT and RIGHT. Each of these words needed a number with it in order to tell the floor turtle how far to move. The final piece of information that I gave the children was that they could teach the turtle to understand new words, or to remember drawings – in this way I hoped to introduce the concept of procedure- writing at the outset, which I felt was important.

'Playing' turtle

With this introduction, I explained all the pieces of hardware to the children, and they started their work with LOGO. Alongside computer-based work, we 'played turtle' together quite a lot in the first month or so. At first I was the turtle, and the children used LOGO commands to direct me around the room. Very soon, the children took turns in being the turtle, often blindfolded. We sometimes used obstacle courses or a predetermined goal, and occasionally used chalk to leave a turtle trail. At times children would play turtle in small groups without me, often to try to solve a particular problem that they had encountered when working at the computer, or to find out how to draw something which they were planning to draw with the floor turtle.

The system of filecards worked well, but we soon discovered that a group of three was too large, and so reorganised ourselves into pairs. The computer keyboard held a fascination of its own, and much time was spent exploring all the keys, including finding out how to get out of LOGO! The inputs to the commands were explored as well – very small numbers produced very little movement, and very large numbers either sent the floor turtle right off the paper, or tangled its cable around it. Settling down with a partner took time and was easier for some of the class than others, and I learned to be flexible about the length of time each group worked. Sometimes the children's play seemed random; at other times they developed structure. My role during this initial month or so centred on keeping a general eye on what was going on around the computer, judging when comment or some practical help was needed, and assessing when a group had come to a natural break in what they were doing and could stop comfortably.

Turtling soon became well integrated into general classroom activities. In the class of twenty-four children, some developed their own goals rapidly and started writing procedures within the first two months; others were content to continue their play and exploration, with a little self-imposed structure, for much longer. I had no pre-determined plan to introduce new ideas, but tried to respond to what I preceived to be the needs of any group at any given time. Occasionally the class as a whole would be stimulated by one group's activities. At other times each group would be absorbed in their own investigations. The children were proud of their drawings and procedures as their own achievements, but did not show any desire to be too possessive of them. So a lot of discussion developed, both at the computer and away from it.

Some of the achievements

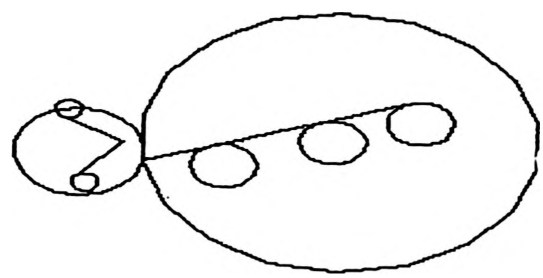
Because of the independent and individual nature of the work done by the children I can only mention a few of their achievements in the limited space here, and touch upon implications. There were many highlights, and group activities which stimulated the whole class or led to an intervention from me. LOGO was available all day throughout the year and so a lot of turtling went on. I have tried to select a few events which seem to me to be important, or were fun, or both!

The first procedures grew from a class interest in one of Christopher and James's drawings which looked like a capital letter A. Soon everyone was drawing letters with the floor turtle, and when Allie and Kate asked if they could teach the turtle to remember their letter S, I showed them how to define a procedure. At the same time, some of the class became absorbed in attempts to draw a circle in order to add a letter O to the class collection. This problem was solved by playing turtle, when Kate verbalised her movements as 'go forward a bit and turn a bit and go on like that'. Within this interest in drawing letters, groups differed considerably in their approach, some keen to define procedures, others content just to draw. The original letter A never became a procedure.

As Christmas approached, our festive turtling included a procedure for a candle which we used on Christmas cards, and Alison and Sebastian's splendid snowman called Picklehead. The PICKLEHEAD procedure was my opportunity to introduce the REPEAT command, so that drawing each of the circles would be less time-consuming.

```
?PO "PICKLEHEAD
TO PICKLEHEAD
PD
REPEAT 18 [FD 30 RT 20]
REPEAT 18 [FD 10 LT 20]
RT 70
FD 30
REPEAT 18 [FD 5 RT 20]
PU
FD 50
PD
BK 50
FD 50
REPEAT 18 [FD 5 RT 20]
FD 40
REPEAT 18 [FD 5 RT 20]
PU
BK 100
BK 50
PD
REPEAT 18 [FD 2 RT 20]
LT 30
FD 30
LT 100
FD 30
REPEAT 18 [FD 2 RT 20]
END

?PICTURE
WHAT'S THE NAME OF YOUR PICTURE?
PICKLEHEAD
```

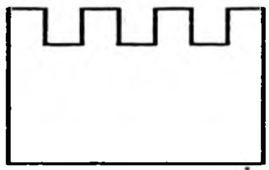


PICKLEHEAD

Much happened in the Spring term. Jola's desire to draw three chairs for the three bears led me to introduce the idea of inputs to a procedure, and also made me aware that in doing so I was also introducing the mathematical concept of a variable to infants – something that was inconceivable within the conventional mathematics curriculum. The three chairs for the bears were a great success; some children went on to use the idea of inputs to a procedure well, as in the example of Allie and Sebastians's castle, called BUMP. During this term, emphasis moved away from the floor to the screen, because some of the groups needed the speed that the screen offered. Subprocedures were beginning to be used more often, and the children discovered some of the classic spin patterns with the screen turtle. The children wrote simple procedures to print out Mothering Sunday poems that they had written, using the PRINT command followed by a list, each list being one line of the poem.

```
?PO "BUMP
TO BUMP :SIZE
LT 90
PD
REPEAT 2 [FD :SIZE]
LT 90
REPEAT 3 [FD :SIZE]
RT 90
REPEAT 2 [FD :SIZE]
RT 90
REPEAT 3 [FD :SIZE]
LT 90
REPEAT 2 [FD :SIZE]
RT 90
LT 180
REPEAT 3 [FD :SIZE]
RT 90
REPEAT 2 [FD :SIZE]
RT 90
REPEAT 3 [FD :SIZE]
LT 90
REPEAT 2 [FD :SIZE]
LT 90
REPEAT 3 [FD :SIZE]
RT 90
REPEAT 2 [FD :SIZE]
RT 90
REPEAT 3 [FD :SIZE]
RT 90
LT 180
REPEAT 2 [FD :SIZE]
LT 90
REPEAT 3 [FD :SIZE]
REPEAT 10 [FD :SIZE]
LT 90
REPEAT 14 [FD :SIZE]
LT 90
REPEAT 13 [FD :SIZE]
PU
HT
END
```

```
?PICTURE
WHAT'S THE NAME OF YOUR PICTURE?
BUMP 8
```



```
BUMP 8
```

Some exploration of the arithmetic operations within LOGO was made, often using large numbers, which the children would not have experience of using away from the computer.

```
?PO "MUMMY
TO MUMMY
PR []
PR [TO MUMMY]
PR [YOU ARE NICE]
PR [AND GENTLE]
PR [I LOVE YOU]
PR []
END
```

The world of sprites

In the Summer term we used Atari as well as Apple LOGO, and this opened up the world of sprites to the class. Everyone enormously enjoyed defining, saving and using their own sprite shapes. Sebastian, Allie and David asked how many collisions there could be with four sprites, and spent an afternoon away from the computer working this out, and then developing a table relating the number of collisions to the number of sprites. Again, through LOGO, something outside the normal mathemetics curriculum had arisen, and was being investigated with understanding and enthusiasm by three children. Some interesting non-graphical work developed through this term: Sarah and Elizabeth wrote a procedure called COX, with two inputs; the READLIST primitive was introduced to help develop an interactional quiz procedure along with conditional statements; and Kate, Macha and Zohra, at the very end of term, started work on a potentially sophisticated conversation procedure.

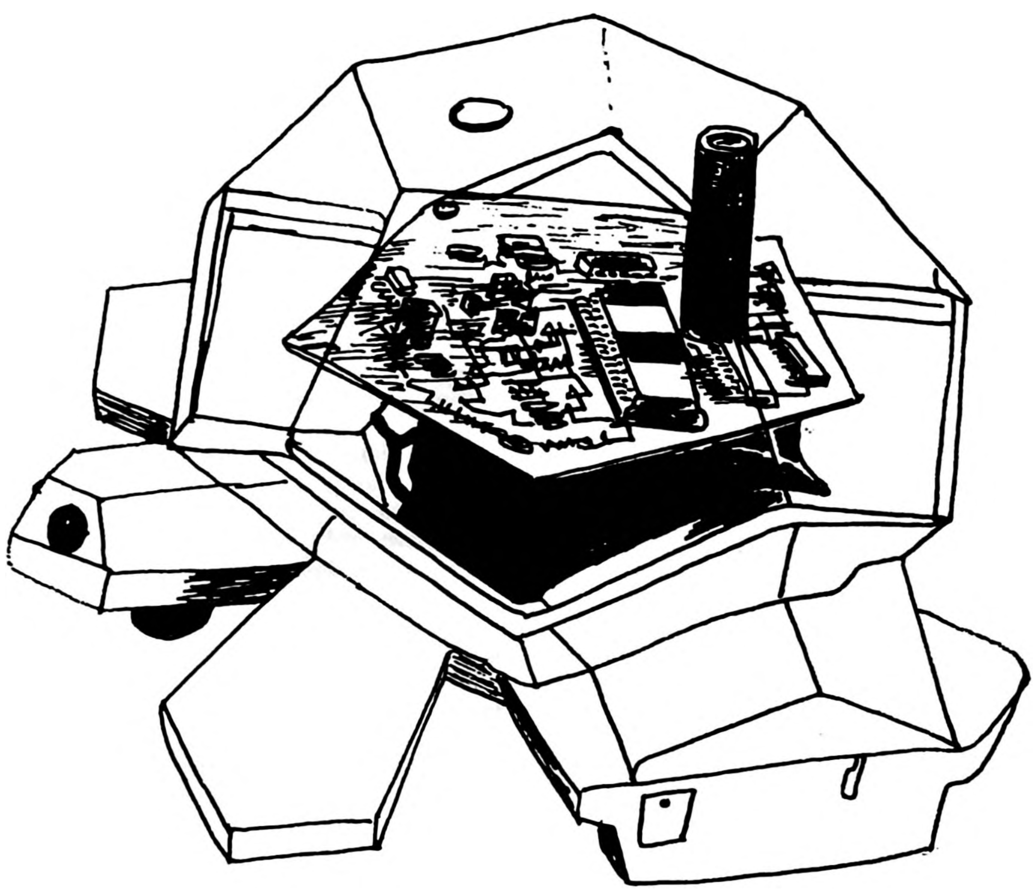
```
?PO "COX
TO COX :NAME :NAME4
PR []
PR SE [TO] :NAME
PR [WE HOPE YOU LIKE YOUR]
PR SE :NAME4 [LOTS OF]
PR [LOVE FROM ELIZABETH]
PR [AND SARAH XXXX]
PR [CLASS 1]
END
```

The children's work ranged far and wide through the year. If I am guilty of emphasising more sophisticated work in this very brief report, it is not to impress, but to show what kind of work actually has been done in a class of top infants. Many children were content to draw with the floor and screen turtles, and to write simple procedures. What all the children gained was a sense of control over a learning environment. For some, this sense of control had become quite complex, for others it remained fairly simple. In either case, the fact that there was control is what is important.

Now, in my second year of using LOGO in my classroom, I have three floor turtles, used by two classes of 6-7 year olds. We are still using Apple LOGO, but have two Commodore 64 systems as well. This year it seems that I am learning about how much I didn't discover last year! And I am even more excited and fascinated by the potential that LOGO holds – for the children, but also for me as a teacher.

P.S.

I have been teaching infants for eleven years, in Hackney and Haringey, in north London. I have no mathematical or computer training – I came to teaching via a degree in Sociology. This year I have registered for a part-time research degree at the University of London Institute of Education, where I hope to investigate further some aspects of young children using LOGO. I am keen to make contact with other teachers of young children using LOGO, and would welcome hearing about their own experience.



Free Turtling by Alan Coode

Headteacher, Southmead Junior School, ILEA

Seymour Papert in his book Mindstorms tells how he developed his enthusiasm for mathematics by using gears as models to help him think. He describes how he loved to rotate the circular objects against one another and how he developed this in his imagination. I wonder where LOGO would be today if that constructional gears set had not worked. Let's imagine that the gears stuck and would not transfer their energy between each other. I am sure that the infant Papert would like all normal humans have disregarded them as playthings and have found other concrete materials to exercise his imagination and creativity on. I mention this because all through the short period we have been using Logo in school the inadequacies of the technology, computers, televisions and the like have conspired to frustrate the children's attempts to make Logo their own. Out first computer was too heavy to move from room to room let alone outside to our hutted classrooms. Hence many children were deprived of having the computer to work with in their immediate environment. The monitors were also heavy and although the solution seemed simple, leave the computers and the televisions set up in the classroom, the security officer would not wear that. Now the problem is the reverse. Recently we had a Macintosh in school and had to lock the room it was in because this beautiful little machine is very portable. It is a tribute to the exciting attraction of Logo that despite all these early disadvantages all those who sense its power seem to continue to want to strive to understand and use it with children.

The arrival of our first turtle

Soon after the arrival of our first computer and not long after the first reading of Mindstorms we purchased a Jessop turtle. At 350 pounds we unpacked it with respect and anticipation. The dome shaped robot promised all "Mindstorms" had suggested. At the time all we had was a heavy black boxed 380z complete with early neolithic software. Playing maze with instructions such as "Press n for north" it hardly appeared as if the micro revolution had reached our school. As if sending an electronic maggot around a maze could offer any challenge to children whose teachers had far more exciting expectations of them. Art has always been important in our school, with its ability to heighten perception and develop children's awareness. We recently celebrated our 25th. anniversary and of all those many marks on paper made over the years all had been made by human hands, that was until we set up the turtle. The first gentle rumble across the staffroom floor with the pendown represented the first mark made by a non human trotter, or what ever turtle's hands are called, that had been created in school. Simple squares appeared in as many coloured pens as Jessops provided and the only disappointment on that first day was the blobs that appeared under the pen when the turtle stopped or when it took too long to turn. The children who were slightly bemused by the enthusiasm of their teachers, began to ask questions which showed that they did not have the blind love of technology that their teachers appeared to display. They found many loop holes in the turtle's performance. The wire linking the turtle to the communicator got twisted and no matter how carefully we all tried the turtle was often pulled off course. This contrasted with the accurate and exciting patterns produced on the television using the screen turtle. The dissatisfaction grew as together we realised that the OKLOGO supplied with the turtle was vastly inferior to the version of ILECC Logo we had been using. Class work with the turtle gave way to small group work after school outside the classroom. The effort of setting up the interface and turtle did not seem to be justified. Surely the physical problems of using the turtle should not detract from the spirit of Logo. However it did appear that the children found the difficulties a hindrance rather than a challenge.

Our new batch of 480z computers arrived giving more children access to LOGO. The next blow came when we found that the turtle objected to being told what to do by these new machines. The manufacturers said the leads were faulty. Nevertheless the turtle only ever worked on the 380z. As it happened, at this time we discovered Atari LOGO with its sprites and multi colours and the Papert dream was rekindled at the same time as the Jessop turtle was put into the cupboard to gather dust. The profileration of Logos hit the market. Somewhere at the back of our consciousness, lurking like a turtle in the cupboard, was the guilty feeling that we were neglecting an essential feature of Logo, that working in the real world was an important quality of the Logo experience. But primary schools are busy places and the problems presented to us by the early turtle were not conducive to free exploration or discovery, unless you counted how to avoid tangling the wire as a Logo problem.

Testing a 'new' turtle

We were approached to test a Valiant turtle because our children had experience of using a turtle. Apprehensively we unpacked this turtle not discarding its polythene egg in case it needed storing like its predecessor. All the specifications suggested that someone had had similar experiences with the early turtles and had sort to rectify its shortcomings. No lead was required, the Valiant Turtle worked through an interface which used infra-red. You could tell which way it was facing without having to stick eyes on it as it looked like a turtle, well it looked like a plastic turtle.

The computers in our school are now being used more as tools. Word processing and databases are beginning to replace the early maths games which dominated the days of the cassette recorder. Into this atmosphere came the Valiant Turtle. A whole range of competence in Logo exists within the school. There are children who are quite good at using Logo and also those who have had little opportunity to explore it. Could we start again with this new turtle, using it to introduce Logo to children whose experience of the computer had not included Logo? One class of children were given the Valiant to use. It was a class of children who had not worked with the computer a great deal and who had been grouped together in this class because they had various difficulties either emotional or of an educational nature. Their level of application was considered to be rather low but using the Valiant they progressed rapidly in Logo passing the stages of drawing squares and triangles with relative ease. Complicated patterns and drawings were possible, the squares were rotated and the turtle coped with the turning not having a lead to contend with. The children developed a high expectation of the turtle's capabilities.

Games were invented for the turtle to play. The children sat around in a semi circle and a set of cards were placed face down beside the computer. Each child had to take a card which had another child's name on it and using Logo they had to turn the turtle to face the child named. Alternatively the cards could have tasks on them, the children had to make the turtle perform the tasks. Draw a triangle, turn Yertle to face the clock, (Yertle named by the children after a character in a Dr. Suess book). The tasks were undertaken co-operatively and the conversation stimulated the children's language development.

The turtle as part of the classroom

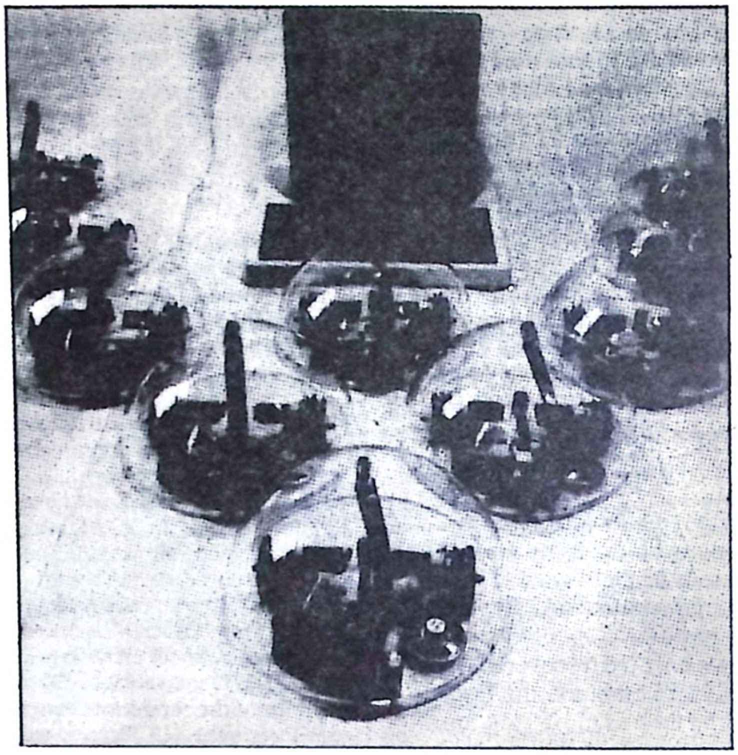
The turtle became very much part of the life of that classroom. It was compared to the class hamster, weighed and measured, drawn and painted. It was no chore to get out as it worked. The children became authorities on its use.

Experiments were carried out to find out how far it would work away from its communicator. The manual said that the turtle would work up to six metres away from base. The children armed with tape measures and computer descended on the school hall during one of their P.E. lessons. The computer was set up and the Valiant sent to the far reaches of the hall. It trundled on away from the communicator until it nearly reached the radiator in the corner. 10 metres away and it still obeyed instructions, well nearly, it found it hard to turn and come back. When the teacher mentioned about sunlight and how that might reduce the effectiveness of the infra-red control the children wanted to try the experiment again on a less overcast day. How the Valiant travelled over different surfaces was another planned investigation. The Valiant can use any pen manufactured by Berol. This makes it possible to produce a wide variety of different effects from fine line drawings using a rollball to fat felt tip blobs. Many differerent pen colours can be and were used to produce colourful pictures, although putting the turtle back in the correct place so that it can continue its drawing after a pen change did present a problem.

We had tried to send the Jessop turtle through a maze constructed of plastic bricks with a certain amount of success. We repeated this activity using the Valiant and the mazes became more complicated. The communicator was pointed at the ceiling and the signal bounced down to the turtle, imitating satellite communications, well, that's what the children said.

Conclusion

We only had the turtle for a short while and it was returned during the long summer break. Our own is due to arrive anyday. Free turtling gives the children the opportunities to explore Logo and enables young children to enjoy a demanding thought provoking activity. They are not constrained by unnecessary physical limitations so their imagination and creativity can be given full reign. Just as the availability of the cheap micro processors enabled computing to come into schools so the technological advance of a turtle that is able to roam free will make it possible for children to use robots to learn with. As Seymour Papert said "You learn by doing but you learn better by thinking about what you are doing. Getting a robot to do something compels you to think about what you are doing and so enhances the learning process." We do have one regret, we should have waited until the technology matched the children's expectations.



Turtling in Gloucestershire Schools by Reg Eyre and Sue Marlow

College of St. Paul and St. Mary, and St. Gregory's Cheltenham.

As the only teacher training college in Gloucestershire, we have tried to provide support for the local authorities teachers in the form of short courses (ten weeks) concerning aspects of educational computing.

These courses aim to show teachers different modes of use of the microcomputer in their classrooms and, it is hoped, that teachers leaving the course will have gained sufficient self-confidence on the course to use the microcomputer in their classrooms with at least six pieces of software. It is also hoped that after a period of time, these same teachers will want to return for another course to see if other aspects of using the microcomputer are possible in their classroom as well as considering the more general educational aspects – for example, is the use of such equipment necessarily of justifiable educational worth?

One other aspect that these short courses highlighted was the need to provide more informal support for teachers who were brave enough to use the microcomputer in their classrooms after such short courses. It was decided to form a Teachers' Workshop on Monday nights at the College. The structure was totally informal and teachers, students and staff were welcome to attend between 4.00 pm and 7.00 pm to discuss problems or ideas.

This workshop gives staff at the College the opportunity to be invited into local schools to see the effectiveness of software currently being produced. It also provides the opportunity to work closely with ordinary classes of school children using equipment that has only been present in schools within the last two years.

This last aspect is most important for teacher trainers. It enables them to gain credibility when talking to teachers about new techniques brought about by recent changes in technology and software. It also serves the aim of providing extended support for those teachers attempting new approaches to teaching styles as well as enabling the partnership of teacher and trainer to effect a degree of on-going in-service training for the rest of the staff of the school.

A substantial amount of time in all courses concerning the educational aspects of using the microcomputer is spent looking at the philosophy behind, and the usage of, LOGO.

Up until July 1983 the only machines likely to be available for school use in the future was the BBC computer. The software situation at that time meant that the only Logo lookalike was "LOGO Challenge" from Heinneman or Adrian Oldknow's "Turtle" from MUSE. By September, Dart became available from AUCBE and I advised local teachers to buy this in preference to other turtle graphics packages.

This situation will hopefully change this September 1984, when at least three full versions of LOGO become available on ROM chips for the BBC computer, and we will be able to put aside our versions of Dart. I must add that children who have used Dart can cope quickly and easily with RML LOGO. Unfortunately, not many schools locally possess RML machines.

What follows is one account selected from a number written by local teachers, who have attended short courses at the College of St Paul and St Mary, and who have attempted to use the turtle graphics and/or the Jessop Turtle in their classrooms. The reason I have been involved with some of these teachers is partly curiosity, to see what happens if one tries to apply the LOGO philosophy in a range of schools, and partly in my role as a provider of teacher training courses wanting to develop alternative in-service training methods within schools.

The teacher's account

The idea was born in the summer of 1983. The project was to work with my class, third year juniors from St. Gregorys School, throughout the Autumn term with Mr. R. Eyre at the College of St. Paul and St. Mary.

Sessions would either take place at school or at College. We had found that it was possible to transport children to and from College from the experience of the previous term when four classes from our school had been bussed to the College to use CLOGO (Logo Challenge).

Mr. Eyre proposed using the DART program with my third year class. I could see that this program had potential; by letting the children be in charge of the computer and learn through their own efforts, errors and experience.

The children's knowledge of computers was limited, some having microcomputers at home. None had used the particular program called Dart. The children would be fortunate enough to have one BBC Model B computer between two during the college visits.

Before the first visit to the college, Mr Eyre visited the class at school and discussed with them the four commands FORWARD, BACKWARD, LEFT, RIGHT, and this discussion led on to angles and degrees. The children noticed that Mr. Eyre did not always type in the full command, but it appeared as if by magic on the screen after pressing one key. By the end of the first college visit most had discovered the use of the function keys.

One boy remarked to me that he had learnt to spell four words, (Forward, Backward, Right, Left), because, if he didn't type them in correctly, the computer would not respond. An aside – this boy's spelling improved dramatically over a period of weeks; is this a spin off from the computer work?

No discipline problems

The working chatter, the cheers, the concentration on the children's faces; these were the things that I noticed in the first session. No discipline problems! Never anytime to take off coats! The jubilation when they had succeeded in the task! Even now this continues and the novelty hasn't worn off. One of the first problems for them to tackle was to draw their initial on the screen – a very personal problem for them.

The next commands learned were BUILD and CHANGE so that the computer could remember their programs. One difficulty some children had was to recall and run their program. All that is needed is to type in the name of the program and press RETURN. Some thought it necessary to type in BUILD <program name> RETURN again, but this difficulty has now been overcome.

During the time at the college the children were introduced to different commands and given tasks to do. Then they were encouraged to experiment with programs, changing numbers and finding out what resulted from these investigations.

After the first visit the children requested pencil and paper and began their own computer books in which they logged their programs and results. After completing the work given, they could spend the rest of the time drawing their own pictures and patterns of robots, rockets, spaceships and flowers. They then wrote up their own programs in their own shorthand.

The children began to understand how to draw regular shapes, triangle, square, pentagon etc. using the primitive language of FORWARD, RIGHT etc, and then incorporating REPEAT and END. The days of learning about external and interior angles are over. The children began to realize that a full turn was 360 degrees, so to draw a pentagon they divided 360 degrees by 5 and this then gave the angle the Turtle would turn through each time.

Many times I found a protractor by the computer which the children had used in conjunction with their work. The screen became Magic, printed by the children to help them work out where the turtle would move to next.

```
PENTAGON
REPEAT 5
FORWARD 50
LEFT 72
END
HOOT
```

By mastering these commands the children began writing programs using procedures already built, e.g.

```
SQUARE
REPEAT 4
FORWARD 50
LEFT 90
END

SPIN
REPEAT 36
SQUARE
LEFT 10
END
```

Six months later, the children are drawing their own pictures using procedures, e.g. WINDOW when drawing HOUSE with four windows. The delight when a window appears in the correct place has to be experienced to be believed.

The floor turtle arrives

The floor turtle arrived at the school in October. The silence and the expectation of the children were thrilling. Their faces full of concentration and anticipation as the turtle moved over the paper drawing out the program. Some eyes crept back to the TV screen to see if the pattern was the same; they found the screen drawing more exact but this did not deter them from the exciting experience of the machine drawing their program.

These nine year old children were asked to write up their account about the half hour visit from the turtle. The results were amazing with drawings of side and top views of the turtle with diagrams and description of what it did and looked like. At no time did I tell them how to present their work – just to suggest some drawing and writing would be necessary. I was amazed at the detail they gave. I felt the visit had certainly caught their imagination.

During the whole term of visits to the college and the turtle's visits to the school, the novelty did not wear off. They still clammered to work on the computer creating their own ideas and pictures on the screen which have now been saved on tape.

At College the children were given free time to try out their own ideas (programs written at school or at home in their own time) before Mr. Eyre introduced them to a new command or idea they could use. They would then experiment with this; increasing the ANGLE, length of SIDE or number of times the program was REPEATED and watch the change in the resulting picture, compared to the last illustration. Throughout this activity, they were gaining experience to use in their own programs. My role during this period was to observe, help when asked to discuss with the children their difficulty, (at first I found it difficult not to press keys and correct their work for them!), in order for them to solve their own problem, communicating with me and others, then resolving it altogether.

Once back at school, the children were eager to complete their work – maybe some discussion of examples which were new to them but generally they wrote up their program.

Working on one computer (shared with the other third year class) was integrated into the day and DART was the only program used with the class. The computer is situated in an adjacent room, separated by screens which is ideal. At first the children only had a large TV screen to use. Then a small b/w TV became available which they preferred (by now they did not need the screen colour change to say which MODE they were working in). The children asked if the large set could be left on as well so they could see what the others were working on (I had a "splitter" made so this was possible). They weren't distracted by it but worked and gave the screen a glance from time to time.

After this concentrated term's work the children still edited and improved on their work, saved on tape. Occasionally I noticed children actually walking out the Turtle's movements so as to get it right on the screen – also arms waving left or right. The children found it easy to correct and improve their work because of the EDIT mode, showing the complete program. If difficulties still reigned, children would invite their friends from other groups to help them out.

I knew when the children were really having fun – REPEAT 3000 the program would say! Great delight seeing the pattern slowly "fill up". Also discussion if the pattern did not seem to alter – do you need to REPEAT all those times I would ask.

Even at the end of the year, children would ask for DART to be loaded so they could see again their own program. The delight on their faces when it was being drawn – like seeing it for the first time all over again!

During the rest of the year, small groups of children went to the College after school to work on DART to improve and write new programs, so the Computer Club was begun.

The "spin-offs"

The "spin-offs" that I have noticed from the children working with this program are varied; from improvement with Maths, especially angles and problem solving, to stickability of a broader nature which-ever subject the children are working on.

The girls especially tended to give up on new ideas in Maths but now actually offer to do Maths by choice! I am sure that this is a direct result of the work with the turtle. They now try out their ideas – changing them and not giving up when things go wrong. Their span of concentration is longer and their willingness to try again is certainly in evidence. They have an awareness of direction and a feel for angles about which they talk with confidence. They can think more abstractly as is evidenced when they BUILD a procedure, i.e. the turtle does not move when building the procedure, so in their thoughts they have to see it move. (Some children try out new ideas before building them).

The children's views

What of the children's thoughts? They all agreed that they would like to use the computer with this program more often. Why? They weren't sure. These are some of the factors they put forward:

"The computer helps me concentrate." Helen

"It helps me in Maths when I'm doing angles, by choosing how far to go round, to make it look what it's supposed to do." Kirsty

"I like Dart because it helps me with my spelling." Ben

"I enjoy doing Dart. It teaches us to draw different patterns and then we can repeat them." Nicola

"I think Dart is very good. It helps me with my Maths because you can change your answer if you go wrong and its fun because you can watch the arrow moving." Caroline

"Fun, helps my drawing angles and spelling." Martin

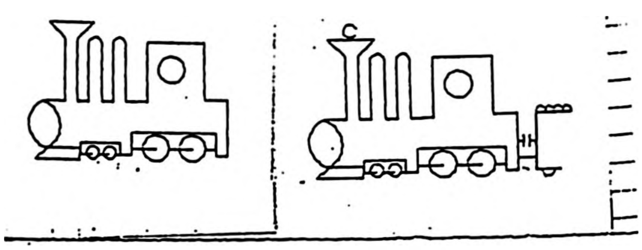
"I like going to computers because it is fun and you have the computer for an hour or so without interruptions." Gregory

The term ended with a Parents Evening at the College. Mr. Eyre spent time with the parents explaining the program. The parents then joined the children in the computer room for half an hour or so listening to their children describing their own programs. Some children designed programs for their parents to try; one child designed a program which had a mistake in it for his mother to find and correct! A most successful evening for parents and children alike.

Problems? Only one – one computer between 34 children at school.

I leave you with one last thought from a child:

"I like Logo because it is fun and it helps you learn about the mistakes you make, so you won't do it again and it also helps you to get your angles right." Sarah



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TRAIN
LT 90 AND LIFT AND BD 30 AND PENCIL 1 AND LT 90 AND FD 10 AND RT 90 AND
FD 50 AND C AND FD 32 AND RT 90 AND FD 10 AND RT 90 AND FD 30 AND C AND
FD 32 AND RT 90 AND FD 10 AND RT 90 AND FD 35 AND RT 45 AND FD 20 AND LT
135 AND FD 40 AND LT 135 AND FD 20 AND RT 45 AND FD 55 AND RT 90 AND FD
20 AND LT 30 AND J AND LT 45 AND J AND LT 45 AND J AND LT 15 AND FD 30
AND RT 90 AND FD 10 AND RT 90 AND FD 40 AND RT 135 AND FD 15 AND RT 45
AND FD 30 AND RT 90 AND FD 5 AND LT 90 AND FD 5 AND LT 90 AND F AND RT
90 AND FD 5 AND LIFT AND FD 5 AND PENCIL 1 AND FD 5 AND LT 90 AND F AND
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10 AND LT 90 AND FD 35 AND LT 90 AND FD 5 AND BD 5 AND LT 90 AND TRAIN2
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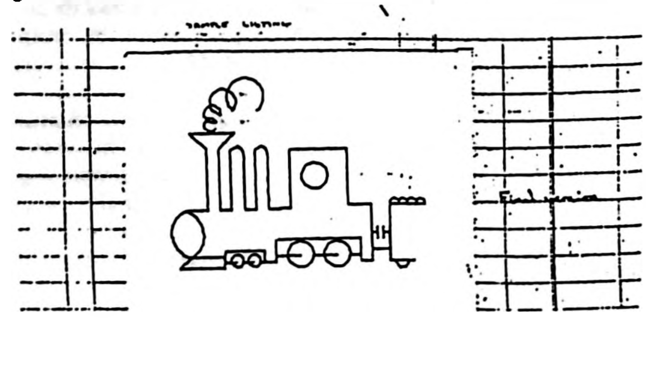
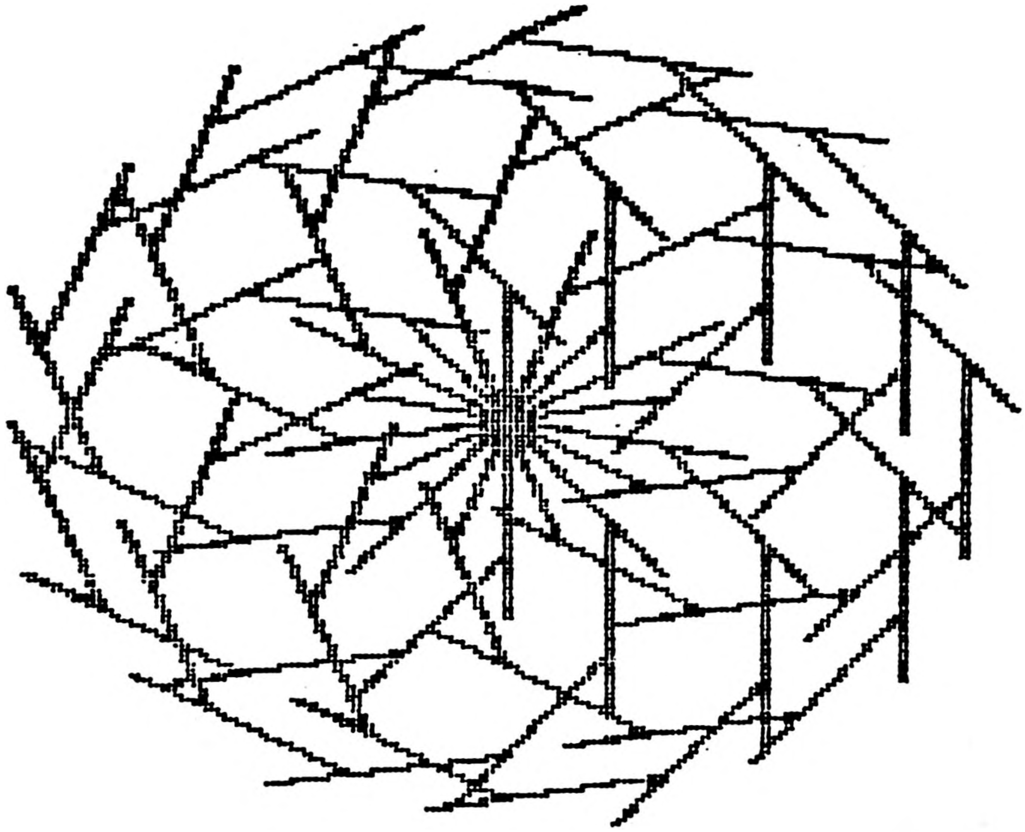




Playing with LOGO. NOTES ON THE BEGINNINGS OF ONE SCHOOL'S LOGO CULTURE.

by Henry Liebling
The Beacon School, Amersham, Bucks.

Our aim is to provide a computing environment for both staff and pupils, and where possible to support and advise parents and pupils with computers at home.

At the Beacon School, a day prep school for 200 boys, computers are used at present almost entirely in an informal way outside the classroom. We have a 3016 PET, an Apple II, a BBC 'B' with Wordwise, Graphics chip and a 40/80 switchable single sided disc drive, a BBC 'B' with an 800K dual double sided disc drive and a Watford D.F.S. on a trolley and three 48K Spectrums (Spectra?) each with a Microdrive. An Epson MX 80 printer sits between the Apple and the Beeb, an Alphacom32 printer ajoins one of the Spectrums.

During non-teaching time, there are twenty-five 40 minute bookings on each of the seven machines per week available to boys aged 8-13. Pupils are encouraged to share and to make their work and expertise available to one another.

Three types of activity currently provide a Computing Environment.

a) Using Software which includes:-

For the B.B.C. 'B':- the four Microprimer packs, which nearly squeeze into one 80 track disc; Slick; Factfile; Quest; the MAPE tape; Space Shuttle; a range of programs from Primary Programs Ltd; and a number of programs which pupils have copied from books and magazines.

For the Spectrum :- The Hobbit; Valhalla; Ballooning; Punctuation Pete; Secret Agent; Flight Simulation; Chequered Flag; Survival; HURG and DRAW.

b) Using Programming Languages.

We have Apple LOGO, Dart for the BBC, LOGO and PROLOG for the Spectrum. If pupils wish to use BASIC then I encourage them to use BBC BASIC. Apple Pilot is also available. LCSI LOGO for the Beeb is eagerly awaited, and its arrival will mean that we will have six machines all running the same syntactical version of LOGO.

c) Using Reference Material.

The small computer room is well stocked with reference books, manuals and magazines including Microscope, The Micro User, Sinclair User, The home computer course, Practical Robotics, Primary Teaching and Micros, and Educational Computing.

At various times during last year six groups of upto twelve boys have had ten weekly sessions on "Starting Logo", using the Apple.

Due to their enthusiasm, staff attended a six session introductory course, in which they learned how to use the BBC computer through looking at software. In the last three sessions individuals were encouraged to demonstrate programs, review the software, and discuss its implications.

This year with four machines capable of running Logo and four groups a week of up to twelve boys engaged in supervised Logo sessions, there should be much more scope for individual and small group work.

How we started.

From October 1983 to March 1984 six groups used Logo for ten sessions of an hour a week. Initially I tried to teach Logo to a group of 14 pupils as we only had one machine running any version of Logo turtle graphics. Whilst being far from ideal the group generated its own energy and ideas came thick and fast. At the end of most sessions we printed out our work and each member of the group was given a photocopy. I hoped that they would then book a session on the Apple and try out the ideas on their own. About half the group were either free or keen enough to pursue this course of action. One even went as far as getting Atari Logo for Christmas. A number joined the ranks of those waiting for full versions of Logo for the Spectrum, they were not disappointed, and the Beeb (failed autumnal promises; hope for vapourware springs eternal).

In the summer term I tried to compete with sport and introduce list processing to two small groups for forty minutes before morning school. This actually worked fine until the Apple broke down and eluded successful repair for most of the term.

I went too far too fast. In a large group situation where hands on experience is scarce there must be fairly frequent success to sustain interest. A large group does have the advantage of generating a number of solutions to the same problem and from which to select the most appropriate. Also the sheer quantity of new ideas sparks off other suggestions. After the first few weeks we readily took turns, reaching decisions usually based on the consensus of opinion.

When, as a short term solution, we obtained (paid for!) Dart and Snail Logo it became possible to have three groups of four pupils using each of the three machines running the three very different versions of turtle graphics. It was interesting to note which ideas and structures were in fact portable.

I tried to interfere as little as possible, but assisted when asked, and each week attempted to introduce one new idea, structure or piece of syntax. The pupils coped with the different versions far better than I did, and the difficulties only seemed to heighten the enthusiasm and excitement generated when at last the screen turtle did as it was told. Some planned on paper, some discussed their ideas on the playground, some fought over the keyboard when they felt enlightened by a good idea, others appeared far more bored and listless than those in the larger groups of 12 or 14 crowded around a fourteen inch monitor.

Towards a Logo "cook book"

I am now resolved to use only full versions of Logo which are at least syntactically similar if not identical, and L.C.S.I. seems the most sensible choice. This springs from the desire to build up a Logo cook book, recipe book, tool kit, call it what you will, filled with useful and interesting procedures, and the need to present Logo as a coherent language which can be built upon. Using toytown Logos is a temporary and possibly retrograde step forced on us by the time lag between the production of hardware and its supporting software and firmware.

The potential of giving pupils a hard copy of their work seems fundamental to building up an understanding beyond simple yet powerful three or four line procedures, as well as giving them the opportunity of study away from the scant resources of hardware.

At this very early and messy stage in our development using Logo, indications are that a combination of:- large group discussion; teaching structure and syntax; use by small groups, pairs or individuals; together with communal or shared storage of work; public access to procedures; and public display of work with Logo; will provide us with the best route to learn and grow in our understanding and appreciation of the power of Logo.

In addition to the above, there were two pupils with good potential but very poor performance in school, for whom it was felt the computer might be a 'good thing'. I introduced them individually to the Apple, showed them how to get Logo up and running, and presented them with a card bearing the commands FD, BK, RT, LT, and CS. From the start I had the feeling that both of these pupils were "first principle merchants". The sort who learn on a 'needs to know' basis. Their perseverance and dedication astounded me especially when compared with their usual exam or homework offerings.

Some pupils who have not attended the group sessions have seen group members using Logo during a booked session or have studied the work displayed, and begged to be initiated into "The Wonderful World of LOGO" by one of the growing number of afficienados, who I call advisers. Is that wise?

For my own part, hardly any geometry teaching is 'turtle free', state transparency is still a new and exciting concept and when faced with a thorny maths. problem, as I stare at the board, one pupil, a BASIC freak, jibes that surely it would be easy if only we used Logo. There must be some truth in that.

A view from the playground.

At the Beacon, computing is seen as a hobby outside the classroom, a non-sporting spare time activity. Advantages to this approach are:- there is very little pressure on the children to use computers; we probably can't do much harm and we might even do some good; Logo is not thought of as the general perfect panacea, children are free to choose if they want to use the computers and some don't; there is time to chat and reflect upon one's computing activity in a busy sometimes noisy but usually friendly atmosphere; it is possible to have reasonable expectations of Logo, given that we are using Spectrums and not IBM PCs. Teachers are not forced to use or even become involved with computers, but as the computers share their space with the spirit duplicator and the photocopier, all staff have a real chance to observe how children use computers. At present maths, science, geography and English staff are keen to bring the micro into their classrooms.

Disadvantages to our informal approach are that computing might not be taken seriously by children, staff or parents, and it might delay the presence of computers in the classroom, (which might be an advantage); it is very hard to keep track of what everyone is up to (arcade style zapping aliens is forbidden); some very good work may get lost or go unnoticed, and it is difficult to trace the development of ideas if no one is there to watch and listen, or work is not saved.

Unlike most schools where computing is seen as an adjunct or alternative to normal classroom practice, at the Beacon children are offered computing alongside activities which normally appeal to boys. These are:-

(1) Play time Logo.

Forty minutes before school, thirty minutes of morning and afternoon break, and a voluntary hour after prep (evening clubs). Logo has to compete with flying a plane, motor racing, ballooning, being a secret agent or the involvement of an adventure game such as Valhalla or The Hobbit. Children share their work in an informal setting. Most work in pairs, but a few prefer to work in threes or alone. I believe that children enjoy interacting with the computer and with one another. watching the T.V. is passive, computing is active and interactive.

(2) Logo as a non-sporting activity.

For one hour twice a week, as an alternative to sport, pupils can choose from Art, Drama, Dungeons and Dragons, Carpentry, Music, Chess, their own activity or Logo. What would you choose?

Writing procedures in Logo.

Generate a new idea.

What procedure exists that is like it?

Is there something around which might do the job?

Are there any tools or black boxes, existing procedures that you might not fully comprehend or even want to understand, that might prove useful?

Write the new procedure.

Keep it stylish and short. Use recursion and nested short procedures where possible.

Make the name of the procedure, sub-procedures and variables meaningful. Try to avoid using MAKE statements inside a procedure.

Debug the new procedure.

Test the new idea.

Logo procedures and people.

A de-bugged working procedure seems to have a number of interesting properties as far as the individual and the group, within the Logo environment, are concerned.

For the individual who produces the procedure there is frustration in making the computer do what is required, followed hopefully by elation when it finally does as it is told.

A new idea is generated, suggested or emerges. An old idea is reworked or adapted. Some express themselves directly at the keyboard experimenting with screen images. Some use direct drive, steering the turtle around and saving their screen images as pictures. A few are planners who work and think away from the keyboard as well as at the computer. The beauty of a Logo procedure is the flexibility it offers and ultimately its raw power and terseness. It is as if children are building their own tools, or should we call them toys, things to be played with.

The procedure must be made to work, saved for another try at another time or abandoned. Rarely have I seen children abandon an idea at the computer with the regularity so frequently found in maths writing, art or science. A Logo procedure can always be modified or changed into something which the originator finds interesting. In fact some interesting ideas have been generated by accident. Rubbing out, editing, saving for next time, starting on a clean page are all so much easier on a computer. Each stage of the development of an idea is accessible in the child's saved work. This allows analysis of the child's reasoning, and debugging skills. You can see how procedures grow, join together or are nested like Russian Dolls to form the main procedure.

Debugging is easier in Logo than say Basic for two main reasons. Firstly using Turtle graphics the child can actually see the mistake on the screen, the classic house with its roof down one side instead of on the top or a misplaced ear on a rabbit. Secondly the syntax of Logo is simple so that the most likely syntax bugs are :- a missing space between words; a missing colon when you mean the value of something; not putting quote marks when you mean the name of something. It is quite acceptable to make a mistake in Logo. The problem is knowing where it is and what to do about it. Group knowledge is invaluable. Children call across the room to one another for help or advice. Like adults and their old cars, once you have had a blocked fuel pipe, water in your petrol, a blown cylinder head gasket, or a knocking big end you remember the symptoms only too well. Fortunately with Turtle graphics the child can actually walk out the procedure with feet or fingers. Head and hand movements like Thai dancers, shuffling around the floor or pointing all over the screen are now accepted as normal behaviour patterns for Logo freaks, as is bouncing up and down shouting "It works, it works!". If it doesn't, then the procedure can be saved, forgotten about for the moment, and returned to at a later date. Some children return to "half-baked" ideas weeks or months later.

The original idea may be clearly and elegantly expressed, or it might be long and rambling, but it can now be accurately stored, recovered, used and adapted by the originator or anyone who has access to it. The ideas may need to be tested further, and might be found deficient in some way; then its back to the 'drawing board'. New ideas are visible as turtle tracks and can be seen by passers by. The school's Logo culture is pulled along by these new ideas, at times, with amazing speed. A faulty or poor procedure has little effect save that it might be improved.

The rewards of a new procedure

To the originator, the idea has continuously been reflected back into his own mind by the computer screen. The new procedure is his own intellectual property, he has validated it, and can now dispose of it as he wishes. It is a bit like learning the hard way without the despair of searching for an elusive or even non-existant solution. Logo is about choices within a fixed linguistic framework.

The finished product is often paraded with joy and confidence, sometimes by shy pupils. Adults and children stand equal before Logo, some are a bit more equal than others! A new procedure increases the confidence and esteem of the originator; he gains the respect of others, and this even seems to happen with copied work, which is often adapted. "Hey! Did Richard really make that maze?" "We used William's pyramid this afternoon. He must be clever. It looks good." "Steven has copied a rabbit out of the Turtleland book, and he's using setscrunch to stretch and squash it. It's verv funny, come and see."

Procedures can be used to conduct investigations. POLYGON with inputs :number.of.sides and :length.of-.side which can be varied is fairly simple, but a procedure like SPIRAL, SPANGLE, SPINGLE, or STAR can provide many hours of mathematical investigation.

As communal property, the new procedure has even greater strength as it is used and explained, adapted and improved, or even used like a black box with little notion of what it contains only the knowledge that it does the job. The thoughts of one individual appear as an image on the screen, to be assimilated by other individuals. The line of reasoning is evident and accessible inside the procedure for those that want it. How I wish I could analyse diagnose and debug their mathematics as easily as their Logo procedures.

Conclusion

Over the last twelve months I've observed children learning to learn, often about themselves, using their own content, inspired and encouraged by a growing Logo community which they have built themselves, a Micro Computer Culture.

I make no excuse for the raw state of this work, neither mine nor the children's, it springs from the sense of urgency and excitement, mixed with feelings of satisfaction and enthusiasm, which a Logo enriched environment seems to produce.

Much of our encouragement has come from Seymour Papert's "Mindstorms"; Peter Ross's "Logo Programming"; Cynthia Solomon's "Programming through Turtle Graphics (Apple Logo Manual)"; Richard Noss & Katrina Blythe's "Turtleland", and more recently Ken Johnson's "Logo Summer School" at Edinburgh University; Peter Goodyear's "Logo, a guide to learning through programming", and the Sinclair Logo Manuals.

Some examples of children's work

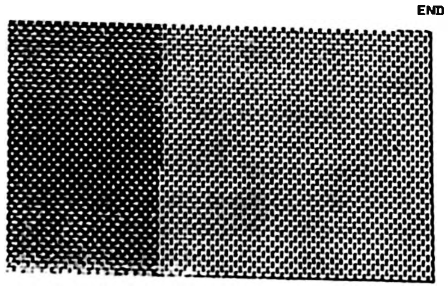
```
I first started computers in the begining of lent '84.
The only thing I knew was that a tape stored information
which the computer could extract when you press "play."
I followed a programing guide when first using the
Commodore.Then I started on the Apple.
It seemed very complicated at first.But then things
started to unravel.
It was the "Turtlegaphics" I liked the most;with a bit
of help,I drew a cirtle on my first day.
I got a time on the Apple and started planning programs
at home.
AT first,I programed in a cube,then,a truncated pyramd
(my dads idea).Then without knowing "pen up" and "pen down"
ever exsisted,I programed a 205 line maze.
I founed out that there was a certen place where the
"turtle would disappear off the screen.I programed
"Curtain" which filled the whole of that limited spaces
with a series of dashes.Unless one pressed "control G"
it would carry on and overlap until evolved into a
green mass.At that moment,it suddenly,or the computer
suddenly made a series of beeps of protest(!)
That was the largist object it show on the screen..........
```

R.J. Ellison

```
TO XYZ
HT
PU
FD 120
RT 90
FD 140
RT 90
PD
REPEAT 140 [ABC]
END
```

```
TO ABC
X
RT 90
FD 3
RT 90
X
LT 90
FD 3
LT 90
END
```

```
TO X
REPEAT 24 [FD 5 PU FD 5 PD]
END
```



William's work. "I think I'll start with a pyramid!"

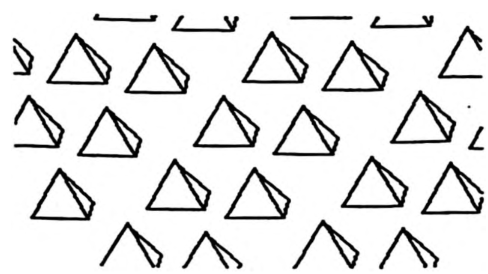
```
TO PYRAMID
RT 90
FD 34
BK 34
LT 70
FD 50
RT 140
FD 50
LT 180
RT 30
FD 17
LT 45
FD 34
END
```

Commands written down after trial + error, then I put them into a procedure for him.

```
TO PYRAMIDS
HT
PD
PYRAMID
PU
HOME
LT 50
FD 100
RT 50
PD
PYRAMID
PU
HOME
RT 50
FD 100
LT 50
PD
PYRAMID
END
```

With some help from his friends.

```
?PO "PYRPAT
TO PYRPAT :TIMES :ANGLE :STEP
HT
PU
LT 120
FD 150
RT 120
PD
PYRAMID
PU
REPEAT :TIMES [PU RT :ANGLE FD :STEP LT :ANGLE PD PYRAMID]
END
```



Ambitious building project completed.

CRACKED TURTLE: and schoolroom ecology

by M.P.Doyle

The Turtle we use at school has a crack running from a screw at the edge to half way up the dome. The crack, how it came about, and the questions generated by it, have led to a re-evaluation of the introduction of LOGO to young children; and of its likely contribution to their conceptual development.

The Crack.

In common with most British classrooms, mine has a shortage of free floor. The problem of where to put the turtle was solved by screwing a 4ft square sheet of chipboard to an old set of table legs. This provided an area just large enough for a model village around which the turtle could be driven. We could, therefore, conveniently do "floor" turtle work as well as more formal turtle graphics.

The Crack happened in what, in retrospect, was a moment of incaution. My class of eight-to-ten year olds and I had been exploring our new aquisition using the software supplied with it, a version of OKLOGO which provides no screen display.

A copy of DART was then acquired. This would allow us to turtle on the screen as well as the table. Michael set to work reproducing one of his drawings, using the screen as a monitor. Suddenly there was a thud, accompanied by a splintering noise. There, on the floor, was the turtle, its dome cracked.

A comparison of movement in OKLOGO and DART revealed that FORWARD (n) in DART is twice as far as in OKLOGO.

The question then arose – just how far is FORWARD 100? What is the Turtle metric? Several runs of FOR-

WARD 10 and FORWARD 100 were recorded. These averaged 34.5mm and 346.5mm respectively.

Therefore: ONE <DART> TURTLE IS 3.465mm

In my classroom it is the convention to use the centimetre as a unit of measurement. We are plentifully supplied with metre sticks and 30cm rules. We also have set squares and protractors.

Because the unit of rotation used in LOGO is the degree of arc, the children establish a culturally valid convention when they program rotations. But, when they learn to estimate distance in Turtles, they learn an aberrant metric.

Axiom or artefact?

Is it a fundamental tenet of the turtle microworld that its units should NOT conform to the metric used in society at large? Or is the arbitrary nature of the turtle unit an artefact? Has the physical substrata of LOGO intruded into its mathematical purity, and if so what might the consequences be?

I hope to shed some light on these questions in three ways. By:

A) Uncovering uncontrovertible artefact.

B) Describing the turtle geometric, rather than turtle graphic, use of the turtle in my classroom.

C) Raising some questions about children's learning.

A. Time and LOGO.

I had adopted the second as the base unit when adding a WAIT command to DART. This was because it is the unit adopted by other classroom timing devices – eggtimers, tockers, stopwatches and clocks and so forth. (It is also the standard scientific unit).

When, at the 1984 British LOGO Users Group conference, I toured the stands of the sellers of LOGO; it was in the secure conviction that they would have done likewise. But no!

Apple LOGO has a unit of 1/60th sec., Spectrum LOGO 1/50th second, the provisional Acornsoft LOGO had 1/10th second, and only RML LOGO defaulted to 1 second!

The Apple and Spectrum units are the interesting ones. The frequency of the electric mains in the USA and UK is 60Hz and 50Hz respectively. The electronics of screen display control in domestic television sets manufactured in the two countries is tied to this frequency. Hence, for graphics control it is a "natural" base to choose.

Here, then, is our evidence of artefact.

B. The SNAIL microworld.

As hinted earlier, our turtle does very little drawing. It is used very much as a computer controlled object which moves in space. To differentiate this use from the production of turtle graphic drawings, it will be referred to as the SNAIL microworld.

In this microworld, the first steps in turtle geometry are based in the child pushing toy cars around the playmat in the nursery. In essence, the technique is to remove the toy car, replace it with the turtle, and say "Make the turtle go from the house to the school." The aim is to make the child reflect upon his own actions.

The guiding principle is that children be given access to the powerful ideas immanent in LOGO as directly as possible.

The microcomputer system used consisted of:

A BBC Microcomputer with a colour monitor and disc drive.

The Jessop turtle (parallel, with umbilical cable).

Concept keyboard overlays were used for input.

Audiotext (Votrax TNT) output was provided.

The Jessop turtle and Concept keyboard were connected to the User Port via the AUCBE multiplexer.

The Jessop turtle was used because its dome could be written on using chinagraph pencil, and the circular form made estimating direction by sighting tangents possible.

Audiotext is a very intelligible acoustic form of language derived from text. Children can, therefore, be given linguistic information through their ears whilst their eyes are watching what is happening.

The concept keyboard overlays were used to provide a more helpful and informative input medium; and to grade access to the software both operationally and conceptually.

The software used was DART; to which the following modifications were made:

1) A WAIT command was added.

2) The base unit of translation was changed from 0.34 cm to 1.05 cm by altering the scaling factor from 2 to 6.

3) Independent scaling of the screen was provided. This ensured that, however far the turtle moved, the trail did not leave the screen.

4) Special codes were added to control Audiotext output, manage the Concept keyboard input, and make the automatic building of procedures possible.

SNAIL in use

The SNAIL environment was our four foot table with model farm on.

The children drove the turtle round by entering information at the overlay. For commands, eg FORWARDS, a single keypress was used. A number pad, layed out using the calculator convention; and an alphapad, arranged alphabetically on a 4x7 grid, were provided when required.

Valid commands were automatically built into a procedure. (An interesting artefact of DART was that the children actually saw the procedure being "written down".)

At the simplest level a single FORWARD move of 10cm was provided, as were LEFT and RIGHT turns of 10 degrees. A strategy of colour coding LEFT (blue) and RIGHT (red) turns was adopted. However, because the turtle "said" (via Audiotext) what it was doing, LEFT and RIGHT were soon established as the preferred labels by the children. This process was also aided by the absence of BACKWARD (omitted at this level because it is conceptually more complex than FORWARD).

Once a journey had been made in "direct drive", the turtle could be replaced at its starting point and the whole sequence re-enacted by pressing the "procedure" key, (in this case called "BUS"). The children then watched what happened, commenting on their earlier decisions; and the consequences of those decisions.

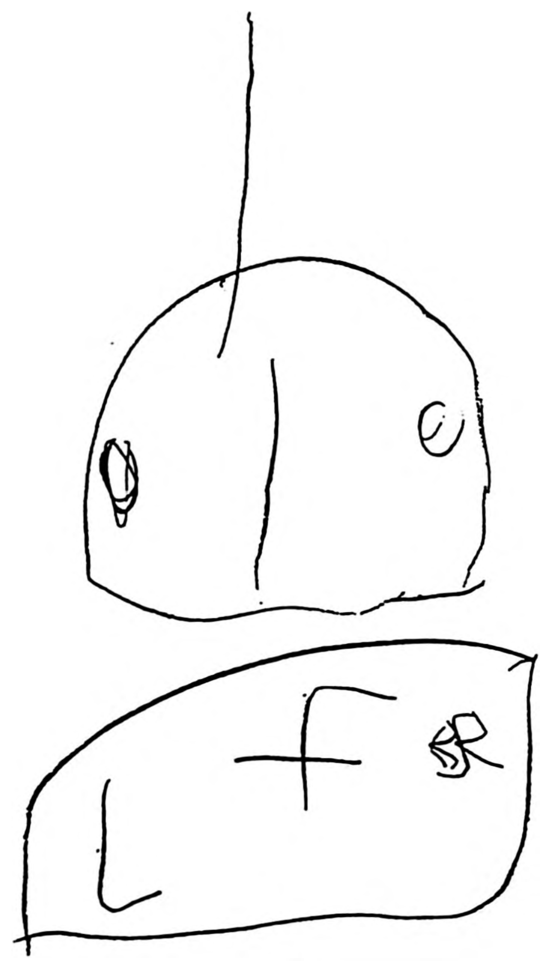
The next step was to add the input of numbers to determine the degree of turn and distance moved. The turtle was provided with marks around its perimeter at 10 degree intervals to help with angular estimation (I wrote on the perspex dome with chinagraph pencil); and the children were encouraged to use their rulers to estimate distance moved. Given that forward 10 was 10.5 cm, the turtle was accurate for all practical purposes.

A LIST-to-printer facility was provided so that the children could examine the program they developed in direct drive, with a view to removing bugs (eg erroneous directions of turn) and simplifying it by adding movements together. The procedures auto-recorded in direct drive could be saved to disc or tape, so the children could reload and edit them using the normal CHANGE command.

These steps lead towards preplanning and program writing in the normal manner, but still within the concrete world of the model.

Is SNAIL valid?

There is no paper product of a journey round a farmyard, however; my impression that the children are concentrating on the critical features is supported by the drawing of the turtle and computer shown below. It was produced by a language disordered, impulsive, clumsy and not very bright small boy, who had only been using the turtle at the simplest direct-drive level.



The turtle itself shows NOT eyes and nose as one might initially suppose; but the wheels, the wire at the front (which he used for orientation) and the wire connecting it to the computer. The drawing of the Concept keyboard shows the three major commands used Left, Forward & Right; and all in the correct place.

This child has chosen to draw the *functionally important* aspects of the turtle; and not its surface form. He has isolated the overlay and the commands on it from the microcomputer and VDU which were closest to it. These latter, being functionally irrelevant, are not represented. It is interesting to speculate on whether this child would have produced a comparable level of abstraction had the Jessop turtle been adorned with tortoiseshell designs on its dome; and head, legs and tail in bright green felt. Or again, had the turtle's form been a concrete representation of the turtle's form been a concrete representation of the turtle zoomorphism with a nautical green pentahedral carapace, circuit board; and bloodshot eyes (a la Valiant)? (Did you know that you can now get furry muffs to keep your turtle warm in winter?)

C. Playing (with) Turtle.

As a pre-LOGO activity it has been the convention to "play Turtle" as follows:

"The child is encouraged to move his or her *body* as the Turtle on the screen must move in order to make the desired pattern."

(Mindstorms P. 68).

The child is directed towards egocentric observation for the information needed to determine the required movement. Is this, necessarily, the most effective approach? Let us look at the world of children; and thence at the information they can bring to turtle geometry.

Instruments.

Children move their bodies around their environment in a turtle geometric manner; true. But, they also move objects, instrumentally, in exactly the same way. They push toys along, they observe objects in movement, they play at moving things all the time. They draw, with instruments. The question which comes to mind is:

Why retreat into sensori-motor actions (which the child, a priori, cannot observe) when there is *instrumental* knowledge there for the teacher to build on? Is it not preferable to draw the child's attention to the *exact manner* in which things naturally move; and in which they naturally move things. Observation, accurate observation, and the intelligent interpretation of observations is, surely, a prime educational goal.

"Playing Turtle" is an extension of the turtle-as-plotter notion. Using one's body to walk turtle may be percieved as similar to self identification which teachers use to establish concepts of distance and measure. But the following should show this not to be the case:

Initially the child's own body is used as referent. The length of a pace, foot, finger. This provides an egocentric standard for the child; but also demonstrates the cultural requirement for objective, communicable standards. Once the concept of a unit of measurement is established, the standardised markings on the child's classroom ruler can become meaningful. Note, however, that the children are using *observable* parts of their bodies, which they can compare directly with the standard.

Symmetry.

"Playing Turtle", in Papert's sense is an extension of the turtle-as-plotter notion. In a large open space like school hall or playing field, the blank VDU screen is easily simulated – but try the same exercise in your classroom!

What happens? You bump into things; just as my children do in the SNAIL microworld. The mathematical symmetry of screen turtle geometry becomes contaminated by consequence – with beneficial effect on the children's spatial awareness (a concrete operational precursor of formal geometry, turtle or otherwise). Turn left at the end of the landing and you go into your bedroom; but turn right and you are in the loo! Or take the letters "b" and "d", the only identifying feature is their directionality.

The symmetry ascribed to FORWARDS and BACKWARDS is even less natural. BACKWARD is far more complex, in both concrete and conceptual terms, than its putative partner FORWARD. Children often use it in the sense of "undo", to recover from a crash. (This mitigates against careful planning and encourages impulsivity.) Although BACKWARD is unique in terms of direction of rotation of the turtle's wheels, its effect may be achieved by a 180 degree rotation, regardless of direction. Natural organisms find a backward movement difficult, if not impossible. And the arrow of time......?

Anyone in doubt about the asymmetry of BACKWARDS might compare its frequency of occurrence in "Mindstorms" with that of FORWARDS.

Drawing.

It is quite fascinating that proponents of turtle graphics start with forms which are classically Euclidean. Consider the following extract from Mindstorms:

"moving in a circle might lead to a description such as: "When you walk in a circle you take a little step forward and you turn a little. And you keep doing it." From this it is only a small step to a formal Turtle program."

These forms are *far* easier to produce using the Euclidean geometric engines of compass and ruler, than they are with a turtle. The *user* of a turtle must know, in some manner, that the sum of the angles of a triangle is 180 degrees. This knowledge is, however, implicit in the design of a compass. Any child who carries out the correct motor sequence can construct polygons using the compass without any knowledge of angle at all.

Reconsider the "circle" derived by the REPEAT (STEP, TURN) algorithm. It is not a circle, it is a polygon. The important thing about Turtle geometry is that you *cannot* draw a circle; only an approximation to one. Circles are the product of a compass – that most Euclidean of engines. It is the fact of *not being able to draw a circle* that provides access to the notions, not only of the differential equation, but of quantum theory as well.

Turtle: physical and fugitive

In the formalism that is LOGO, screen and floor turtles are isomorphic. In corporeal reality they reflect, and are constrained by, their physical substrata.

The Turtle as plotter

If the history of the physical turtle is examined, it will be seen that it has come to be used, in the main as a graphics plotter. That is, a direct equivalent of the VDU screen turtle. Screen and floor turtle are considered to have an exclusive or relationship. One uses the one or the other to produce the drawings.

The screen turtle is realised, on school microcomputers, within the constraints of the TV screen control electronics; and these are based on Cartesian geometry. The screen performs its plot from point X1, Y1 to X2, Y2 instantaneously regardless of the distance moved.

The physical turtle, on the other hand, must run its electric motors for a given time to cover the distance specified.

The screen displays the product of a command, whilst the physical turtle displays the process of its execution. The screen, so managed, is not isomorphic with the floor turtle because the temporal relations are not maintained. Those who complain of the slowness of "circle" drawing might consider whether FORWARD 100 is not, in reality, REPEAT 100 (FORWARD 1); for this is precisely what the physical turtle does.

It *is* possible to arrange for the screen and physical turtle to be active at the same time (this is the case with DART); however, the relationship between the two can hardly be considered satisfactory. In particular, in my SNAIL microworld, whereas I can say the screen turtle has drawn a map of where the physical turtle went; I cannot say that it is drawing such a map. The process is not on view, only the product.

Classroom ecology

If the turtle be a plotter, part of an exclusive, novel, computer culture; then the following may be true:

....when told to FORWARD 10 the Jessop moved 3.7cm whereas the Valiant moved 4.7cm. When used as an educational tool, the absolute distances don't really matter, just as long as 10 LOGO units are twice as big as five units,.....

(Geoff Naim, Acorn User, Nov. 1984, P.164)

On the other hand, if LOGO, the turtle and the computer are to become part of the classroom's ecology; then they must be congruent at all points of contact. If this is not so then LOGO will wither away and die, just like the Initial Teaching Alphabet did – and for the same reasons.

Conforming to convention *restricts not one jot* the manner in which the turtle is used. No child will be aware that the turtle moves in centimetres until told so. However, as the turtle moves around, a perception of units of distance which is culturally valid (and practically useful) will be developed. If it is felt necessary, the unit may easily be anthropomorphised by adding an input; thus, Shabir might make the turtle move in his own finger-lengths. Which, then, should the turtle emulate? Should it have a zoomorphic egocentric metric, or should it conform to the cultural norm? The answer is straighforward. Each turtle is not a hand-crafted original. Turtles are the manufactured products of our culture and, just like the classroom ruler, they must conform to the cultural convention.

Artefact.

It is far more difficult an engineering task to build a turtle which moves accurately in, say, millimetres, than to build one which moves accurately in an arbitary unit. As a plotter, it is more important that the turtle be accurate, than that it move in conventional units. Jessop's are quite open about the design of their turtle, accurate drawing was the criterion; and the unit step of 1.75 mm was pure accident.

Logo and the Legend of Casey Jones by J. Dale Burnett

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The chemistry of a new idea often involves combining simple elements – in this case the elements were (1) an awareness that Logo lends itself to situations that consist of easily defined modules (Burnett, 1982) and (2) an article (Card, 1983) which suggested that one could design an interesting game by putting together graphic units to simulate model train layouts.

Two modules are initially apparent – a straight track and a curved track. Without yet considering any particular layout, one must first convince oneself that the idea is both feasible and potentially interesting. Constructing a piece of straight track in Logo is absurdly simple:

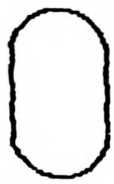
```
TO S
 FD 10
END
```

Curves are a little trickier. A couple of possibilities suggest themselves. One is to work such a procedure out from first principles. Another option is to simply copy the appropriate procedures for drawing arcs from any one of a number of Logo sources. The procedure RCP (Watt, p.270) gives a procedure for drawing an arc of radius :R and "length" 10 degrees:

```
TO RCP :R
    RT 5
    FD :R * 3.14159 / 18
    RT 5
END
```

Without much difficulty one can see that the following procedure will give a layout corresponding to that which every child who has ever received a model train will recognize – the rounded rectangle.

```
TO LAYOUT
   HT
   S S S S
   REPEAT 18[ RCP 20]
   S S S S
   REPEAT 18[ RCP 20]
END
```



The only feature that is unrealistic is the small size of the curved pieces. Rather than 10 degrees a more typical value is 30 or 45 degrees, thereby requiring only 6 or 4 pieces to form a semicircle instead of 18. This is easily done. The important first stage has been completed – the idea appears feasible.

Now an important new level of question asserts itself. What do interesting track layouts look like? As before, the two main options are to design a few oneself or to find some that are ready-made. Larson (1969) provides a choice of 65 different layouts using 8 different track sizes. The little boy in me was emerging – the mind's eye is a powerful motivator. They may be simply lines in a book (or on a computer screen) to the uninitiated, but for me they were the skeleton of a rich fantasy.

Once again my conservative problem-solving nature suggested that I start with something simple. Simple problems serve the important psychological need of bolstering one's confidence during the important formative stages. They also often serve as an important learning tool by revealing certain features of the task that may not be self-evident apriori. Such insights, obtained early and in a relatively non-threatening situation, often permit one to avoid more costly errors later on. I decided to try Plan 1.

It is the familiar rounded rectangle. However there are differences, not in the shape of the design, but in the precision of the description. Using something called the AHM (Associated Hobby Manufacturers) standard, I now know that a piece of straight track is 3¾" and that a piece of curved track has a 7" radius and subtends an angle of 30 degrees. Thus:

```
TO S
  FD 3.75
END
```

(Note: Since only the shape and not the actual size of the layout is important, one may substitute "turtle steps" for inches.)

```
TO C
  REPEAT 3 [ RCP 7 ]
END
```

The layout thus becomes:

```
TO LAYOUT
  HT
  REPEAT 2 [ S S S S C C C C C C ]
END
```

This version is dependent upon noticing the repeating pattern. Being on the lookout for patterns constitutes an important part of what it means to do mathematics.

Once again success. New ideas immediately suggest themselves. The diagram is too small. However since I am working on a screen display I can arbitrarily change the scale to suit my needs.

```
TO LAYOUT :SCALE
  HT
  REPEAT 2 [ S S S S C C C C C C ]
END
```

where:

```
TO S
  FD 3.75 * :SCALE
END
```

and:

```
TO C
  REPEAT 3 [ RCP ( 7 * :SCALE )]
END
```

Then LAYOUT 1 yields:

(the same size as before – a nice check on the scale factor) and LAYOUT 2 gives:

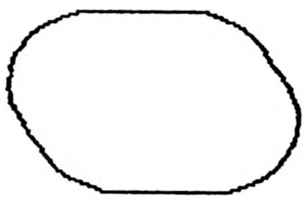
This provides a nice illustration of the power of the concept of a variable (as exemplified with :SCALE). Another important mathematical concept slipped in! The next refinement is to have an initialization procedure (INIT) that moves the turtle to an appropriate location before commencing the drawing.

LAYOUT becomes:

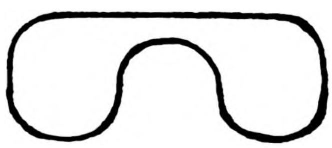
```
TO LAYOUT :SCALE
  INIT
  REPEAT 2 [ S S S S C C C C C C ]
END
```

The next plan in the track layout book is also an easy one:

```
TO PLAN2 :SCALE
  INIT
  REPEAT 2 [ S S C C S C C C C ]
END
```



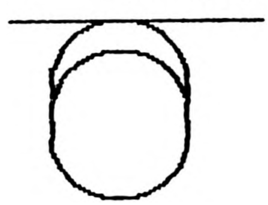
The accompanying figure uses a scale factor of 2.
Plan 6 seems to be straight forward as well:



But

```
TO PLAN6 :SCALE
  INIT
  S S S
  C C C
  S S
  C C C C C C
  S
  C C C C C C
  S
  C C C C C C
  S S
  C C C
  S S S S
END
```

yields:



It makes a difference whether the track curves to the left or right! By accident all curves attempted so far have had the same (right) curvature. Again two approaches come to mind – one from Logo, the other from previous experience as a child with train tracks. The logo solution is to write another RCP procedure that turns to the left instead of the right. At this point one would have three track procedures : S (Straight), CR (Curve Right) and CL (Curve Left).

The child solution with "real track" is to turn the curved track around and use the other end. Thus from an aesthetic perspective it would be nice to stay with just two track procedures, S and C, and to have a procedure that "turns the track around". Modifying the RCP procedure for drawing arcs to include provisions for a + or – sign, plus a procedure BACK.CURVE which effectively "turns the track around", yields:

```
TO RCP :R
  RT ( :SIGN * 5 )
  FD ( :SIGN * :R * 3.14159 / 18 )
  RT ( :SIGN * 5 )
END
```

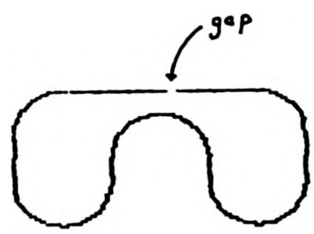
We want :SIGN to be +1 when we want a right curve and –1 when we want a left curve.

```
TO BACK.CURVE
  RT 180
  MAKE "SIGN :SIGN * (-1)
END
```

Remembering to initialize SIGN (to + 1) in the INIT procedure, we then obtain:

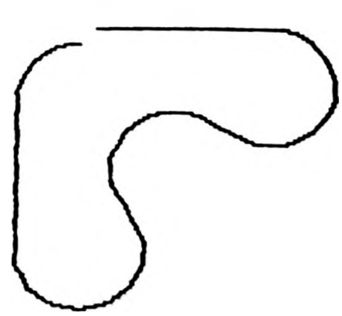
```
TO PLAN6 :SCALE
  INIT

  S S S
  C C C .
  S S
  C C C C C C
  S
  BACK.CURVE
  C C C C C C
  BACK.CURVE
  S
  C C C C C C
  S S
  C C C
  S S S S
END
```



The figure is likely to spark at least one question – why do the tracks fail to meet (by just a tiny bit)? With real tracks this is not a problem. One simply moves the tracks ever so slightly until they do join. But from a mathematical perspective they fail to meet. It is an interesting mathematical problem to calculate just how large the gap is. The length of the long straight section is 7 S sections (7 x 3.75 = 26.75 units). The corresponding length of the curved sections is equivalent to 2 diameters of the curved tracks (2 x 14 = 28 units). Thus we will be short by 1.25 units. The exercise provides an important contrast between the precise world of mathematics (and computers – since we may not have suspected that the track would not meet perfectly without seeing the graphic display screen), and the physical world of laying tracks where the difference would be easily adjusted (and one may still lack the awareness that the layout is not "perfect"). Engineers (and potential engineers) should enjoy this distinction, as should mathematicians (and potential mathematicians).

Plan 7:



Plan 7 is also interesting, in part because it has a different shape (triangular rather than rectangular). Once again the layout is not perfect, although a more interesting problem is that of determining the proper number of curved tracks to use for the total layout. Thus if you add (or delete) one curved track the overall appearance is affected substantially (try it). What is the pattern that resolves the layout so that the left side and the top are perpendicular to each other? It may be helpful to recall that the total turning along any closed path is an integer multiple of 360 (cf. Abelson & diSessa, p.24).

So far we have only explored simple closed (or nearly closed) layouts. However anyone who has ever seen an actual model train layout is likely to be familiar with more elaborate configurations. In particular, switches. From our perspective two features of switches are immediately interesting: (1) how do you draw them? and (2) how do you make them work? A more elaborate consideration is to have something (eg. the turtle) move along the pre-drawn track and then to branch according to the switch setting.

Returning to the simulation of running a train on the track, it is possible to imagine a hierarchy of tasks of increasing difficulty. The simplest level is that of just keeping the turtle on the track. Next would involve layouts with operating switches. This could be followed by situations involving more than one train. Recent enhancements to logo such as sprites might be very useful here, particularly with a collision detection feature. The real affectionado might want to try composing master procedures that simulate a timetable. On a different track (ouch!) there are a number of puzzles in books and magazines that require the user to find a sequence engine.

ar The purpose of this article was not to give answers but to suggest an environment that appears to be particularly rich for exploration. Hopefully the procedures given here will only act as catalysts for the development of even richer layouts. It may even make an excellent year long class project.

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Logo Made Difficult by R. Quentin Miller

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"Data structures + Algorithms = Programmes" – Niklaus Wirth (designer of ALGOL, Pascal, and Modula computer languages)

In recent years LOGO has become very popular for use in the classroom. However, many LOGO users, particularly those who are familiar with BASIC (or Pascal or FORTRAN or similar languages), have trouble writing more advanced LOGO programmes. Often this is because they never become accustomed to the way things are represented in LOGO.

We have all seen things such as instruction manuals that have obviously been written in a foreign language and translated word-for-word into English. Such translations are seldom successful. Fluency in a language involves being able to represent ideas using idioms and structures peculiar to that language. This also applies to computer languages. Too many LOGO programmers represent problems and their solutions as they would using BASIC. The result can be awkward, since programmes and data are structured quite differently in the two languages.

The difference in progamme structure is what most LOGO enthusiasts cite as making LOGO better than BASIC for teaching. Modular programming (i.e. using function calls instead of GOTO's) is not only a powerful concept, but it is fairly easy to grasp and most LOGO users become proficient at it with a bit of practice. LOGO's data structure, however, is in some ways less intuitive than that of BASIC. Consequently, most new LOGO users never fully grasp it and they wind up using LOGO lists as if they were BASIC arrays. (The distinction will be explained later.) This is a pity, as it hinders people in progressing beyond drawing polygons and spirals. There is some exciting work being done using LOGO for natural language processing, games, and other applications which make use of LOGO lists. There are only a handful of simple concepts one needs to grasp in order to understand this advanced LOGO programming. Despite their simplicity, however, the concepts are somewhat unnatural and they take a bit of working with to become comfortable with them. But that is all part of becoming fluent in any new language.

Consider a collection of items. The items could be numbers, words, sentences, students, programmes, or what have you. BASIC represents such collections as arrays. An array is an ordered set of N elements numbered 1 to N (or sometimes 0 to N-1). LOGO, on the other hand, represents such collections as lists. A list is also an ordered set of elements, but its length is less important than the length of an array. Also, where an item is in an absolute position in an array (for example, A(3) is at the 3rd position from the beginning of A), its relative position is more important in a list (it comes after a certain element and before a certain other element; or it is at the very beginning or end). A LOGO list is composed of two parts: the first element and the list containing everything except the first element.

FIRST and **BUTFIRST** decompose lists into those two respective parts. **FPUT** composes a new list of those two parts. That is,

FPUT (FIRST :LIST) (BUTFIRST :LIST)
always returns :LIST. For example,
FIRST [SHE SELLS SEASHELLS] = "SHE
BUTFIRST [SHE SELLS SEASHELLS] = [SELLS SEASHELLS]
FPUT "SHE [SELLS SEASHELLS] = [SHE SELLS SEASHELLS]

All the LOGO programmes which follow make use of these fundamental operations.

The other important list operations are **LISTP**, **WORDP**, and **NUMBERP** which determine the nature of a piece of data, and **EQUALP** which compares two data objects for equality. **EMPTYP**, which is equivalent to **EQUALP []** or **EQUALP "**, is useful because it works for both words and lists. All list operations can be built out of these 8 operators.

The following examples are written in Apple LOGO. Other dialects of LOGO may use **REST** for **BUTFIRST**, **PUTF** for **FPUT**, **RETURN** for **OUTPUT**, or **LISTQ**, **WORDQ**, and **NUMBERQ** for **LISTP**, **WORDP**, and **NUMBERP** respectively.

Often a flag is used to mark the end of a BASIC array. That is, if the first I elements of the array are significant, then the (I+1)th element is a special flag value like 0. Determining the length of the array, then, involves searching for this flag and subtracting 1 from its position.

```
FOR I=1 TO N
IF ARRAY(I)=0 THEN LENGTH=I—1 ELSE NEXT I
```

Finding the length of a LOGO list is different, because the list does not have elements in numbered positions. We can break the list into two pieces, which will help because counting a shorter list is easier than counting a longer list.

When we break up the list (let us call it ":LIST"), we get the first element and everything else. These are returned by **FIRST :LIST** and **BUTFIRST :LIST**. The length of the list is the sum of the length of these two parts. Of course the first element is a single object so counting it is very easy – it is 1. So this is how our list-counting programme can work:

```
TO COUNT :LIST
OUTPUT 1 + COUNT BUTFIRST :LIST
END
```

The only problem with this is that in defining our programme, we are using the very programme we are defining, i.e. **COUNT**. This is known as "recursion" What saves us is that counting a shorter list is easier than counting a longer list, as was stated above. Every time **COUNT** uses **COUNT**, it uses it to find the length of a slightly shorter list. Eventually, COUNT will be used to find the length of a completely empty list. This shortest list is the easiest to count – its length is 0. So if **COUNT** watches out for this simple case, it will work on any list.

```
TO COUNT :LIST
IF EMPTYP :LIST [OUTPUT 0]
OUTPUT 1 + COUNT BUTFIRST :LIST
END
```

Let us see how this works with the list, **[SHE SELLS SEASHELLS]**.

COUNT [SHE SELLS SEASHELLS]
evaluates to
1 + COUNT [SELLS SEASHELLS]

COUNT [SELLS SEASHELLS]
evaluates to
1 + COUNT [SEASHELLS]

COUNT [SEASHELLS]
evaluates to
1 + COUNT []

COUNT []
evaluates to
0

Therefore:
COUNT [SHE SELLS SEASHELLS]
= 1 + COUNT [SELLS SEASHELLS]
= 1 + (1 + COUNT [SEASHELLS])
= 1 + (1 + (1 + COUNT []))
= 1 + (1 + (1 + (0)))
= 3

It is worth noting that the details of this calculation are not apparent in the programme. What we have written is not so much a procedure for finding the length of a list as it is a definition of the length of a list in more detailed terms. The length of a list is the length of the first element of the list (i.e. 1) plus the length of the rest of the list.

This method would be inappropriate for counting the elements of a BASIC array. Since an array is composed of N parts we want to count those parts one at a time. A loop is the obvious choice for doing this. But a LOGO list is composed of only two parts. Since the second part is also a list, it is natural to use the same operation to count it as is used to count the original list. More generally, to operate on a BASIC array one uses a loop (**FOR I=1 TO N**) to operate in turn on each element. In LOGO, one operates on the **FIRST** part of the list, then recursively on the **BUTFIRST** part of the list. A check for the case where the list is empty ensures that the recursion will eventually end. The rest of the examples work this way. Recursion in LOGO is not merely an interesting trick; it is the natural way to manipulate lists.

MEMBERP :ELEMENT :LIST returns **"TRUE** if **:ELEMENT** is a member of **:LIST**; **"FALSE** otherwise. We can use the same approach to write **MEMBERP** as we used for **COUNT**. If the first element of **:LIST** is **:ELEMENT**, then **MEMBERP** returns **"TRUE**. Otherwise, it returns **"TRUE** or **"FALSE** depending on whether or not **:ELEMENT** is a member of **BUTFIRST :LIST**.

```
TO MEMBERP :ELEMENT :LIST
IF EQUALP :ELEMENT FIRST :LIST [OUTPUT "TRUE]
OUTPUT MEMBERP :ELEMENT BUTFIRST :LIST
END
```

When we take into account the trivial case where **:LIST** is empty (as it eventually will be if **MEMBERP** keeps using itself recursively without finding **:ELEMENT**) then we have the complete programme.

```
TO MEMBERP : ELEMENT :LIST
IF EMPTYP :LIST [OUTPUT "FALSE]
IF EQUALP :ELEMENT FIRST :LIST [OUTPUT "TRUE]
OUTPUT MEMBERP :ELEMENT BUTFIRST :LIST
END
```

LAST is a fairly simple programme, since the last element of **:LIST** is also the last element of **BUTFIRST :LIST**. The simple case we check for is a list containing only one element (i.e. a list whose **BUTFIRST** is empty). The last element of such a list is also the first. One additional case we must check for is an empty list – we shall arbitrarily define **LAST []** to be **[]**.

```
TO LAST :LIST
IF EMPTYP :LIST [OUTPUT :LIST]
IF EMPTYP BUTFIRST :LIST [OUTPUT FIRST :LIST]
OUTPUT LAST BUTFIRST :LIST
END
```

BUTLAST is a bit trickier. We noted earlier that for any **:LIST**,

:LIST = FPUT (FIRST :LIST) (BUTFIRST :LIST).

If we put the first element of a list onto the front of the rest of the list, we get the original list. Now, if we put the first element of a list onto the front of the rest of the list with the last element missing (i.e. **BUTLAST (BUTFIRST :LIST)**), we get the original list with the last element missing. So the basis of **BUTLAST** will look like this:

```
TO BUTLAST :LIST
OUTPUT FPUT FIRST :LIST BUTLAST BUTFIRST :LIST
END
```

There are two simple cases to be considered here, since **BUTLAST** of an empty list and a single-element list both return an empty list.

```
TO BUTLAST :LIST
IF EMPTYP :LIST [OUTPUT :LIST]
IF EMPTYP BUTFIRST :LIST [OUTPUT []]
OUTPUT FPUT FIRST :LIST BUTLAST BUTFIRST :LIST
END
```

Let us see how that acts on **[SHE SELLS SEASHELLS]**.

BUTLAST (SHE SELLS SEASHELLS]
evaluates to
FPUT "SHE BUTLAST [SELLS SEASHELLS]

BUTLAST [SELLS SEASHELLS]
evaluates to
FPUT "SELLS BUTLAST [SEASHELLS]

BUTLAST [SEASHELLS]
evaluates to
[]

since **BUTFIRST [SEASHELLS]** is empty.
Therefore:

```
BUTLAST [SHE SELLS SEASHELLS]
        = FPUT "SHE BUTLAST [SELLS SEASHELLS]
        = FPUT "SHE (FPUT "SELLS BUTLAST [SEASHELLS])
        = FPUT "SHE (FPUT "SELLS ([]))
        = [SHE SELLS]
```

Do you see how it works? Like **COUNT**, it does not present a method for generating the result, but it is a more detailed definition of what the operation returns. It takes a while to get used to programming this way.

LPUT, which puts an object at the end of a list, is similar to **LAST.**

```
TO LPUT :OBJECT :LIST
IF EMPTYP :LIST [OUTPUT FPUT :OBJECT :LIST]
OUTPUT FPUT FIRST :LIST LPUT :OBJECT BUTFIRST :LIST]
END
```

How can we reverse a list; that is, change **[SHE SELLS SEASHELLS]** into **[SEASHELLS SELLS SHE]**? It can be done in the same way we have done everything else so far. We can write an operation that acts upon the first element and acts recursively on the rest of the list. The first element must go on the end of the result; we can use **LPUT** for that. As for the rest of the list, we can use recursion to operate on it, as usual. So our programme puts the first element of the list on the end of a reversed version of the rest of the list. Finally, of course, an empty list reversed is unchanged. Here is the programme:

```
TO REVERSE :LIST
IF EMPTYP :LIST [OUTPUT :LIST]
OUTPUT LPUT FIRST :LIST REVERSE BUTFIRST :LIST
END
```

Earlier it was stated that the absolute position of an element in a list is generally less important than its position relative to other elements. This is very true of a list of words in alphabetical order. Let us write a programme to insert a new word into an alphabetically ordered list.

Here is the strategy. If the new word comes before the first element in the list, it is placed at the beginning of the list. Otherwise, the first element of the list is placed at the beginning of the rest of the list with the new word appropriately inserted in it. We shall assume that we have an operation **COMPARE** which takes two word inputs and outputs **"LESS, "EQUAL**, or **"GREATER** if the first word is alphabetically less than, equal to, or greater than the second, respectively. Finally, if the list is empty, then the new word always goes at the beginning.

```
TO ALPHABETIZE :WORD :LIST
IF EMPTYP :LIST [OUTPUT FPUT :WORD :LIST]
IF (COMPARE :WORD FIRST :LIST) = "LESS [OUTPUT FPUT :WORD :LIST]
OUTPUT FPUT FIRST :LIST ALPHABETIZE :WORD BUTFIRST :LIST
END
```

If we have got an unsorted list and we want it sorted, this next function uses **ALPHABETIZE** to insert the first element of the list into a sorted version of the rest of the list.

```
TO ALPHABETIZE.LIST :LIST
IF EMPTYP :LIST [OUTPUT :LIST]
OUTPUT ALPHABETIZE FIRST :LIST ALPHABETIZE.LIST BUTFIRST :LIST
END
```

This next programme takes as input a list of numbers and returns the average of those numbers. The two additional inputs are known as accumulating inputs. They are used to keep running totals. To find the average of the numbers in **:LIST**, one would execute **AVERAGE :LIST 0 0** to initialize the running totals.

```
TO AVERAGE :LIST :TOTAL :COUNT
IF EMPTYP :LIST [OUTPUT :TOTAL / :COUNT]
OUTPUT AVERAGE :BUTFIRST :LIST :TOTAL + FIRST :LIST :COUNT + 1
END
```

REVERSE can be re-written to use an accumulating input, namely **REVERSEDLIST.**

This input keeps the backwards list which is being built up from elements of **LIST. REVERSE** would initially be executed with a **REVERSEDLIST** input of [].

```
TO REVERSE :LIST :REVERSEDLIST
IF EMPTYP :LIST [OUTPUT :REVERSEDLIST]
OUTPUT REVERSE BUTFIRST :LIST FPUT FIRST :LIST :REVERSEDLIST]
END
```

Programmes which use accumulating inputs tend to be much harder to write than to understand. It is not terribly important to be able to make use of this technique to write more advanced LOGO programmes, but one should understand how it works when one sees it in someone else's LOGO programmes.

Note that assignment (i.e. the **MAKE** operation) is not used in any of these examples. When one writes recursive programmes, assignment is seldom necessary or appropriate. If an operation for manipulating lists has MAKE operations in it, then there is often a simpler way of writing it.

The often-heard cry of "LOGO is so easy to learn" is misleading. The concepts in the above examples can be very difficult to grasp initially. Until they become second nature through practice, it is easier to write BASIC-like programmes in LOGO – which is often even easier than writing them in BASIC! But unless a style of recursive programming is adhered to by a novice, LOGO fluency will not be achieved.

Interested readers might try writing the following recursive LOGO programmes (without using MAKE or REPEAT):

ITEM :I :LIST – returns the **:I**'th element of **:LIST**

POSITION :ELEMENT :LIST – returns the position in **:LIST** of the first occurrence of **:ELEMENT.**

This next one is trickier:

FLATTEN :LIST – returns a version of **:LIST** with the words intact but the sub-list structure removed. For example:

FLATTEN [[A B] [C] D [] [[] E]] returns **[A B C D E].**

If you are ready for a big challenge, try using LOGO lists to model sets (elements in a set appear at most once and in any order) and write programmes to find set differences, unions, intersections, and equivalences.

APIO - Approaching education by Boris Allan

The APIO criteria are systemic concepts which can be used to try to bring some coherence to the analysis of teaching and learning methodologies with an emphasis on the organization of knowledge.

These thoughts concerning the ways in which knowledge is transmitted and organized were stirred into life at a conference where a speaker (Uri Leron) was talking about 'Piagetian learning', and the modified approach 'quasi-Piagetian learning' he had developed. The relevance of the APIO criteria goes beyond Leron's argument, but Piagetian learning is as helpful a topic as any with which to start.

Piagetian learning

The conference at which Uri Leron spoke was that of the British LOGO User's Group in September 1984, and Piagetian learning plays an important role in the development of work using the computer programming language LOGO. The term 'Piagetian learning' was coined by Seymour Papert [Mindstorms, 1980] to describe a philosophy of education, a philosophy which Papert also terms 'learning without a curriculum'.

In Papert's interpretation of Piaget – a view not universally accepted – the child is an epistemologist, or a philosopher of knowledge, in that the child is trying to make sense of the world, has the potential to think about thinking. Papert's interpretation of Piaget is almost in keeping with the idea of the child as scientist-psychologist, for ever experimenting, which is an important part of personal construct theory.

This idea, which Papert says he takes from Piaget, of learning without a curriculum does not necessarily mean spontaneous, free-form classrooms or simply leaving the child alone.

"It means supporting children as they build their own intellectual structures with materials drawn from the surrounding culture. In this model, educational intervention means changing the culture, planting new constructive elements in it and eliminating noxious ones".

Papert [1980:31-32]

The reason why the content of Uri Leron's lecture was worrying is the quotation from Seymour Papert. I do not understand the aim of LOGO as being that of leaving children to their own devices and (given the above quote) neither does Papert so suggest. Leron's legitimate concern was that some teachers and educationalists had equated learning without a curriculum with 'learning without a teacher', and thus LOGO was being viewed with suspicion because it seemed to remove the need for any teacher.

Given Papert's views, above, this is not the case, and it is unfortunate that such an impression has been promoted by both supporters of LOGO and its detractors. In discussing the content of a forthcoming book on LOGO, one LOGO enthusiast asked why I had written what she termed a 'structured' book. Why, she wanted to know, did authors not write unstructured books which simply said: here is LOGO, go ahead and use it. The Holy Grail seemed to be the search for no structure.

Such a firmly structured unstructured approach, which seems to derive its thesis from learning without a curriculum, ignores different levels of knowledge. Such an attitude confuses the ways in which information is assimilated by a child, with the ways in which such opportunities for assimilation are presented to a child, with the ways in which such a presentation is or is not integrated: all ultimately depends on the orientation of the educational approach.

It is also important that the entire concept of 'Piagetian learning' seems a contradiction in terms, especially when applied to methods of teaching. I consider that deciding to allow children to use LOGO – even without a teacher or curriculum – is in fact a decision about teaching methodology. Even if the teaching methodology was to educate without teachers, it would still be a teaching methodology.

On the one hand, there is the form of curriculum which strictly defines certain specific objectives without defining the methods by which such objectives are achieved – the traditional approach in schooling and generally recognized as being a 'curriculum'. On the other hand, LOGO has a curriculum which has set general aims (an orientation) together with a philosophy of learning, which is implemented in a special way of presenting the child with learning experiences.

The first type of curriculum has restricted objectives (though more general aims usually intrude), the second curriculum has restricted methods (though more general methods usually intrude). A curriculum in this sense is 'a regular course of study' (OED), and the regularity comes in the Piagetian scheme from its progression through stages.

A personal construction

Piaget's ideas of stages, where the child has to progress through each stage before he is ready for the next, is remarkably structured and presupposes a curriculum. Papert de-emphasizes Piaget as a stage theorist, because such a programme is 'essentially conservative, almost reactionary, in emphasizing what children cannot do' [1980:157], Piaget's ideas have contributed towards Papert's knowledge-based theory of learning, a theory that does not divorce the study of how, say, mathematics is learnt, from the study of mathematics itself.

When one establishes what is meant by Piagetian learning, or learning without a curriculum, it can be seen as a modification of personal construct theory. Personal construct theorists see educational growth as not being the accumulation of more and more facts, but as the development of an increasingly complex concept structure for organizing and interrelating ideas. George Kelly saw the education system as an advanced case of 'hardening of the categories', which also seems to be part of Papert's case.

There is an emphasis in LOGO on the benefits to be accrued from the constructive use of errors (learning from one's mistakes), together with the notion of the child as epistemologist (thinking about thinking). It is not surprising that these emphases are congruent with the notion of the person (in construct theory) as 'scientist-psychologist'. In construct theory, a person goes through life from his birth onwards as if he were a scientist, making hypotheses about the likely outcome of various actions.

These hypotheses are based on the person's construction of the situation (including past experiences and future expectations) and are either validated or invalidated by events. Any validation or invalidation will then be available to modify that person's concept structure. Construct theory thus incorporates the importance of learning from one's mistakes as an integral part of the theory – not as something which has to be separately emphasized.

APIO criteria

It can be seen, therefore, that not only is theorizing in LOGO not distinctive, and I suspect that personal construct theory provides a superior basis to Piaget, but also the notion of a curriculum (or lack of a curriculum) is confused in the minds of some LOGO supporters.

One of the more important developments in the use of LOGO with children has been the increasing recognition of the place of the teacher. Uri Leron, when he was explaining about non-Piagetian learning, said that the question was not whether the teacher should intervene, but how such intervention should be managed.

Personal construct theory emphasizes that the ways in which a person organizes information depends very much on the person and that person's experiences: what is accounted 'information' depends very much upon that person. The person is the most important part of the framework, followed by the organization of information into what passes for knowledge. In this sense, personal construct theory has many similarities with symbolic interaction theory.

The APIO criteria concentrate on the organization of knowledge, and different levels of knowledge: the criteria are Assimilation, Presentation, Integration, and Orientation.

Assimilation

This is the process by which the individual organizes information, and derives knowledge from the world. In simplistic terms, assimilation is along a continuum from the purely inductive to the purely deductive.

Presentation

Opportunities for an individual to learn, or assimilate, have to be organized: the organization of assimilation is termed presentation. The presentation of learning experiences can range from the existential (or exploratory) to the behavioural (or drill exercises).

Integration

The organization, or lack of organization, of presentation is termed integration. Integration ranges from the structured (or purposive) to the amorphous (or aimless).

Orientation

The organization of the integration of methodology is known as the orientation of the methodology. The orientation of any approach can be examined from many viewpoints, but one I wish to emphasize is the individualist/collectivist continuum, and the relation of the individual to society.

Piaget emphasized assimilation, and the move from Concrete to Formal stages (inductive domination to deductive domination). From assimilation there was then a move by Piaget to means of presentation, integrated by his notion of stages, tied together by the orientation which saw the child as an epistemologist.

Using APIO

In trying to evaluate the place of LOGO we are not assisted by the confusion of the above levels. In addition, we are not helped by an interesting asymmetry: we cannot have assimilation without a person, presentation without assimilation, integration without forms of presentation, and an orientation without a form of integration; however, our orientation controls the forms of integration, which controls the forms of presentation, which controls the implied forms of assimilation.

Ultimately, a necessary condition for education is the person and assimilation, and the education process is controlled by the orientation of the educators. It is this asymmetry between condition and control which is accentuated by LOGO, due both to its novelty, and to its explicit concern with orientation and assimilation.

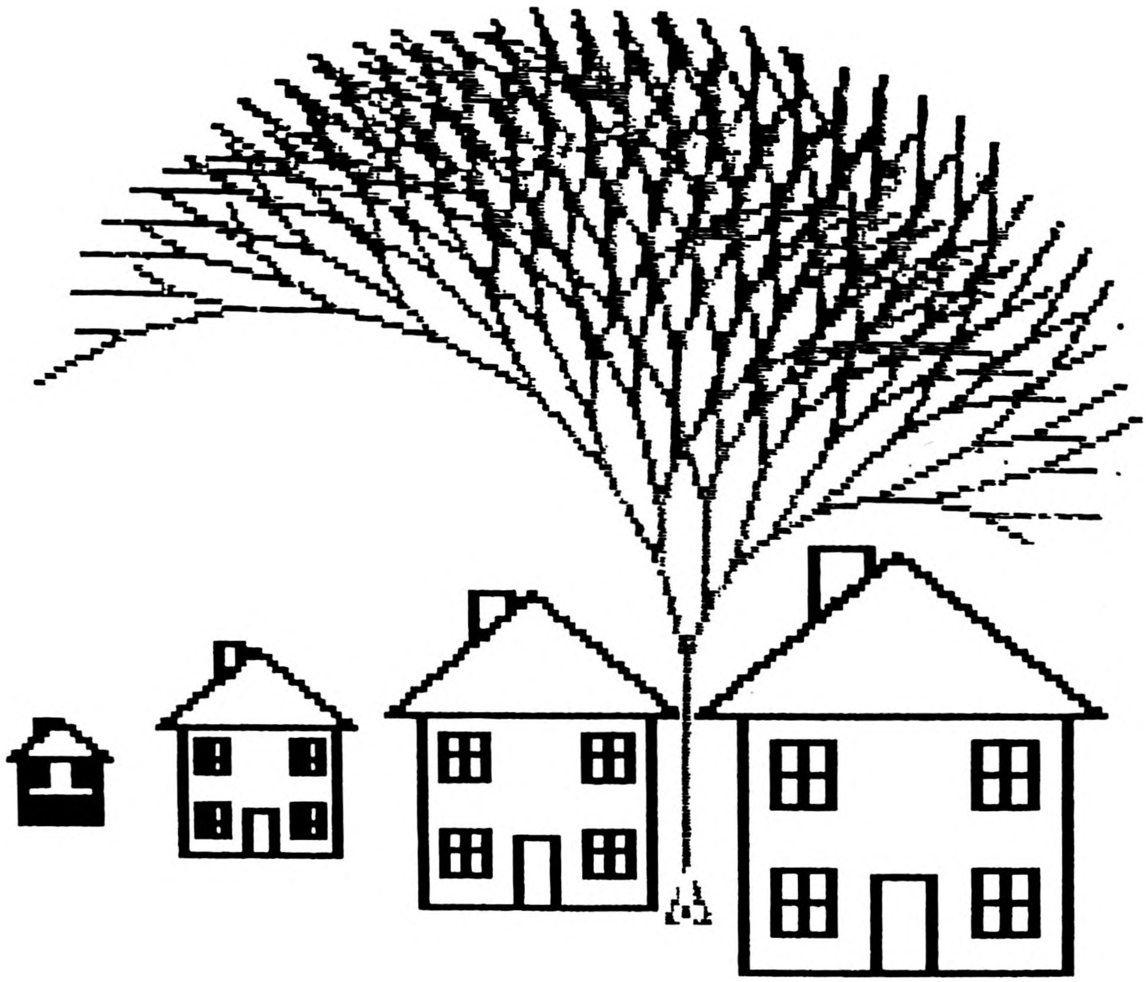
My unstructured friend confused presentation with integration, partly due to an undeveloped orientation. The emphasis on the existential mode of presentation (let the child explore) is not in conflict with a structured mode of integration (a presentation of ideas and problems according to a consistent framework). The reason why such an unstructured approach was suggested is that the emphasis was on the conditions of learning, and not on the control of learning.

Conclusions

1. Most experience of using LOGO is with young children. Young children have a more clearly developed inductive than deductive sense, thus they were able to learn from doing in a concrete sense.
2. The uses of LOGO with which individuals are familiar consist of the turtle graphics facilities, which allow an existential mode of presentation which works well with most people (at any age). The success of turtle graphics can be seductive to the onlooker, because it promises a learning process truly under the direction of the individual.

Unfortunately, it becomes difficult to make further progress unless one has a clear idea of the form of integration.

3. The question of what comes after turtle graphics in the use of LOGO is indicative that there are no clear ideas about the organization of presentation. To have an existential (exploratory) form of presentation does not imply an amorphous form of integration. Teacher intervention is a key part of integration. To repeat: it is not whether the teacher intervenes, but how the intervention is managed. In conventional terms, though the manner in which the topics are treated is up to the child, the topics should at least follow some framework.
4. The integration can only make sense if there is a clearly specified organization of the integration, the criterion I have named Orientation.



WHICH LOGO?
by Richard Noss, Julian Pixton, John Wood

What follows is an extract from a much lengthier and comprehensive article of the same title which first appeared in The Times Educational Supplement of 1.3.85 and is reproduced here with permission.

The decision on versions of Logo is not restricted to sofware alone. Out of the two decades in which Logo has been implemented, it is only in the last two or three years that it has been available on the micro computers that are within the budget of the home and school user. The lack of compromise between power and accessibility inherent in the Logo philosophy has placed great strains on the effectiveness of current microcomputer implementations of the language. It will be a further year or two before affordable computers will be able to run versions of Logo which are genuinely capable of providing fast efficient applications. In other words, almost all of the versions discussed in this document are themselves a compromise with the small memories and slow processors of the machines.

As far as schools are concerned, many are deciding that Logo is an activity to which they are prepared to commit at least one machine. We are therefore entering an era in which schools may be buying Logo machines rather than computers for which Logo may offer one possibility. For this reason the following table provides some information, not only about the Logo implementations themselves, but also some guidelines as to the nature and prices of the computer systems themselves.

Comparison of systems

Logo (3)	*Total memory**	*Workspace*	*User (Bytes)*
Amstrad CPC 464	Ind.	64K	10 525
Apple II c/e	75.00	128K	35 920
Atari 800XL	Incl.	64K	23 090
BBC Acornsoft	59.50	32K	11 936
BBC Logotron (LCSI)	59.50	32K	13 800
BBC LSL	59.50	32K	not available @
BBC O.U.	69.95	32K	15 510
Commodore 64	34.95	64K	14 330
RML (480Z)	39.00	64K min.	not available
Spectrum (48K)	39.95	48K	11 385

** Prices approximate (ex VAT) ** Not necessarily all available to user.*
@ No primitive to access amount of free memory

Amstrad CPC 464

This cutdown version of Digital Research's DR. LOGO is provided free to all purchasers of the AMSTRAD disc system. Written in C, it runs rather slowly and has a number of key primitives missing. It is, however, possible to replace all the missing primitives with Logo procedures.

Good points are the full screen editor which allows groups of procedures and global variables to be easily manipulated, adherence to a reasonably standard syntax, and the inclusion of features such as property lists, error handling through CATCH and THROW, and access to a number of powerful system variables and properties.

Bad points are the slow speed of processing, the omission of a number of key primitives such as LAST and LPUT, and a feature of the workspace management which prevented either of the two recursive list processing tests to run, responding with the error 'out of LOGO stack space' when it clearly was not. This is a serious bug, which detracts from an otherwise reasonable product.

Apple II c/e
The version which runs on the upgraded (128K) IIe and the standard IIc is called Apple Logo II, to distinguish it from the original – now classic – Apple Logo. It is a much more powerful implementation than the original, and offers music, a full set of file-handling primitives, including access to random access files, and an 80-column screen editor. It is written, like the original Apple Logo, by Logo Computer Systems Inc. Apple Logo II comes with very comprehensive documentation which provides an introduction to turtle graphics, and a well-presented reference manual covering the complete language.

Atari Logo
Atari Logo is available on a cartridge for the Atari 600 and 800 series computers. It has a very large workspace available for the user and it is fast. It is unique among micro-based Logos, in that it includes multiple (4) redefinable sprites (dynamic turtles) as standard. These can be controlled by the very powerful WHEN 'demons', which sit inside the computer ready to be activated WHEN their condition is true. This means that the user can write Logo lines which, translated into English, say things like: 'WHEN the CLOUD obscures the SUN, change SKYCOLOUR'. Once this condition is set up, it will be activated whenever the CLOUD sprite obscures the SUN sprite, without having to be run inside the program. The documentation is clear and well presented.

There are no trace facilities to aid debugging, and the music facility, although accessible, uses only two of the Atari's four channels. Also, due to the constraints of space, some key advanced primitives such as REDEF, TEXT and DEFINE have been left out of the implementation.

BBC Acornsoft
Acornsoft Logo is on two chips, and provides a very full version of the language. It is firmly based on the LCSI dialect, although it was written in the UK. It offers a number of features not found on genuine LCSI implementations, such as multiple turtles and an extended set of list-processing primitives. It also offers comprehensive documentation and a set of cassette-based Logo examples for the beginner and more advanced programmer to investigate.

There is a wide variety of extension materials which accompany the package, and some excellent debugging and trace facilities which are unequalled on other current micro implementations. Acornsoft Logo is, however, extremely slow, and anything other than turtle graphics can become very tedious. In addition, the fact that Logo always reserves 10K for screen memory, even when in MODE 7, cuts an already small workspace down to miniscule proportions, and makes serious applications impossible without a second processor.

BBC Logo Software Ltd.
LSL Logo is on a single chip which has a WHILE primitive, and includes debugging primitives WALK and TRACE. It also incorporates a novel documentation which is comprehensive, but unfortunately full of errors.

LSL Logo's editor is not a wordprocessor style full screen editor (unlike the others reviewed in this report), and it is unable to manipulate lists, or to handle groups of procedures. It is not possible to save a workspace or group of procedures as a file (instead, each procedure needs to be individually SAVEd), and it is difficult to save variables. Two non-standard and problematic features of the implementation are the use of commas to separate multiple statements on a command line, and the use of any style of brackets to delimit lists (which rules out their use as a way of facilitating readability). The PRINT primitive does not supply a carriage return (to get one, one has to employ the RPRINT primitive). Other problems are: an incomplete set of error messages, an ineffective garbage collector, a turtle shape which is badly skewed in MODES 2 or 5 when heading 0 degrees (but not when heading 1 degree), and the fact that it is possible to overwrite the text window using the XMARGIN and YMARGIN primitives and thus destroy the screen turtle.

BBC Logotron
Logotron Logo is a fast and very efficient LCSI implementation on a single chip, which boasts an editor with an automatic search and replace facility. It incorporates a new and powerful USE command which provides a 'clean' interface for building extensions to the language – a new departure for LCSI Logos. A prototype sprite hardware extension exists which, when released, will add 32 sprites to Logo; a further extension will include the facility to read and write data files.

LCSI have redesigned their workspace management primitives for Logotron Logo, and have incorporated file handling facilities – an important addition. The implementation has omitted a number of primitives due to pressure of space, and relies on the BBC's operating system commands for all disk access. The space constraint has also led to the ommission of some whole words for which only abbreviations are allowed, although the relatively large available workspace offers the opportunity to reinstate the most important of these. Logotron Logo comes with clear documentation, which usually introduces list processing ideas as well as the usual turtle-geometric introduction.

BBC Open University
The OU version has an excellent reference documentation and a beginners' tutorial manual. It also offers a wider than usual range of control primitives which include the CASE command, and a very fast and powerful flood fill feature accessed through the PAINT command, which allows closed regions to be filled with colour. A weak point is the editor which only allows one procedure at a time to be manipulated, and does not handle variables.

OU Logo is on two chips, and offers multiple turtles. It is, however extremely slow in its graphics plotting. It is a non-standard implementation which has abolished the colon to denote the value of a variable, thus blurring the distinction between variables and proceduers. This last characteristic marks OU Logo as a departure from other implementations, and necessitates a readjustment of the model or 'story' which programmers need to keep track of what is happening. It may also limit the applicability of the growing range of Logo literature.

Commodore 64A
Commodore Logo was produced by Terrapin Inc., who – like LCSI – have been associated with micro implementations of Logo from the beginning. The syntax differs slightly, most noticeably in the 'quoting' of procedure names. For example, Commodore Logo requires

EDIT SQUARE

rather than the more conventional

EDIT "SQUARE

All procedure definition takes place within the editor. One very convenient facility is the ability to switch between full graphics screen, mixed graphics and text, and full text screen; each is accessed by simply pressing one of the three function keys. Commodore Logo also allows the loading (from disk) of a music extension, and software-driven 'sprites' – which are effectively multiple turtles. Commodore Logo documentation is packaged with a densely written manual which is not always easy to use.

RML 480Z
Written at the Artificial Intelligence Lab. of the University of Edinburgh, RML Logo is a full implementation which differs somewhat from the American dialects. It is highly consistent, but it does not adopt a list-based structure for its conditional or repeat statements. Similarly, it is not possible to output a procedure as a list in order to modify it. The turtle consists of an arrow which draws rather slowly, and disappears when in FAST mode. RML Logo demands considerable sophistication from the user wishing to create a startup file; this requires a text editor. RML Logo's documentation, while comprehensive, has been criticised for its lack of clarity and poor layout.

Spectrum
Spectrum Logo is a no-frills LCSI implementation which offers a more-or-less standard LCSI documentation. All keywords are entered in the normal way – BASIC-style one-press keys have been overriden. With one exception, the user never has to press more than two keys to enter a character; the exception is leaving the editor which involves going into 'extended' mode, and then pressing C. The auto-repeat facility is not controllable by the programmer, and is irritatingly fast. Other minor irritations are the way error messages wait for a keypress before handing back control, and the small text window. Spectrum Logo is on a cassette which loads surprisingly fast and can, with a minimum of effort, be copied onto a microdrive tape. A feature of the implementation is the access it offers to the outside world via the idiosyncratic but expressive STARTROBOT command.

NB The authors have between them been involved to a greater or lesser extent, with the specification or documentation of the following Logo implementations: Atari, Acornsoft, Logotron, OU, Spectrum.

Richard Noss is a lecturer in Mathematics Education at the University of London Institute of Education.
Julian Pixton is director of the Walsall Logo Project.
John Wood is a lecturer in the Micros in Schools Project at the Open University.

The abovee TES article stimulated the following correspondence which appeared in the TES of 15.3.85

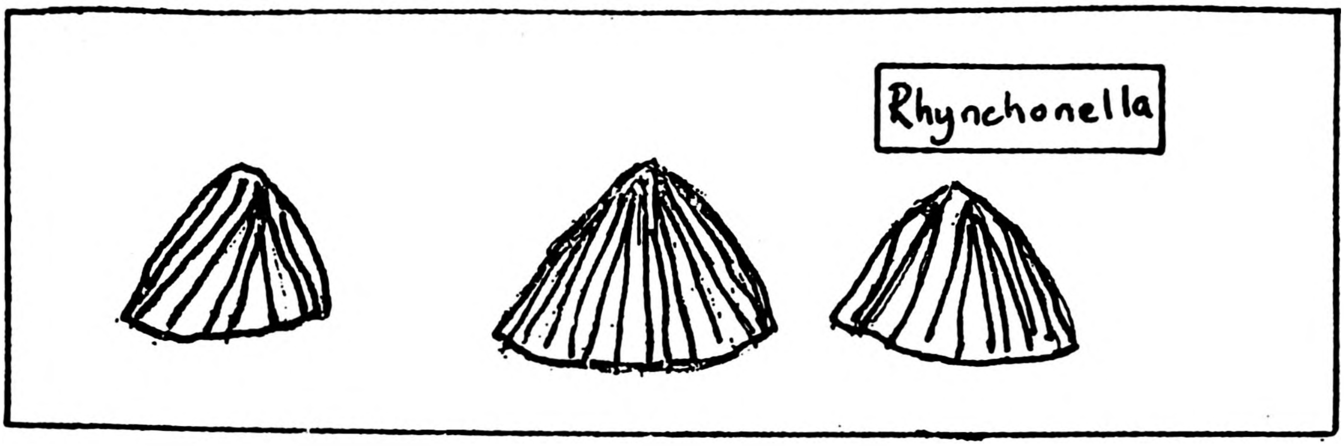
LOGO points
Sir – Your LOGO survey (*TES* Extra. March 1) contains a serious error: LSL LOGO does, indeed, include the IF ... THEN ... ELSE command. It is described on page 98 in our *Young Person's Guide to LOGO* (written incidentally, for a reading age of 10) and on page 31 in the *Technical Specification*, under the heading IF, it is also listed in the *Glossary* and in the *'List of Primitives* (under *Control*).

LSL LOGO will do SIEVE 50 (that is, print a list of all the prime numbers in the first 50 numbers) in 8 seconds, about half thee time taken by its closest rivals in your time-test.

C SQUIRE
for LOGO Software Ltd

John Wood, Julian Pixton and Richard Noss write: The version which we reviewed did not do the IF ... THEN ... ELSE command though this command was in the specification. The SIEVE procedures, which were not listed in the article because of lack of space, could only be implemented in a limited way in LSL LOGO and therefore a benchmark comparison with the other versions of LOGO is not possible.

Perhaps the moral for readers is to examine and evaluate any LOGO Software on approval or inspection before buying.



Fossil "hunting"; digging out the Information. Microcomputers and Palaeontology by the children of Class 5R

Fox Primary School, Inner London Education Authority

[This account of the use of a microcomputer in helping analyse the findings of a fossil "dig" was written by the second year junior class of Fox School. Comments in square Brackets [] have been added by the class teacher.]

We have been collecting fossils from a chalk quarry on the North Downs. We've been studying the fossils, and using the computer to help us sort them out.

When an animal dies its flesh soon rots away, or is eaten by other animals. The shell fish that died in the chalk seas 100 million years ago rotted away, except for their hard shells. These gradually turned to minerals, and got fixed and squashed in the mud that became chalk. So fossils are the remains of the shellfish that lived millions of years ago.

Millions of years ago, before men were alive, there were seas in this part of Britain. The sea bed had become thick with tiny shells that made chalk. Then the earth changed, and the sea bed was lifted up to become dry land. The fossils were now in the chalk cliffs on land. Millions of years passed. Trees and plants grew on the land. Rivers and glaciers changed the shape of the chalk cliffs. They got worn away in places.

The need for chalk long ago

People arrived. A hundred years ago, some people wanted chalk to make chemicals. They dug chalk from quarries. One quarry was at Pebblecombe on the North Downs, twenty miles south of school. Then they stopped using the quarry. It became overgrown with weeds and plants.

The quarry was deserted, with its fossils in it, until classes 5R and 5M went there to find fossils in September 1984. We wanted to dig out the fossils of the shells that had died millions of years earlier, caught in the chalk rocks.

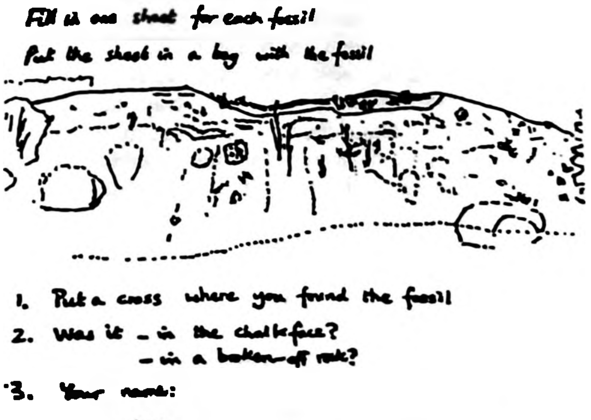
The quarry was enormous. There were cliffs about 40 feet high. We could see the layers of chalk running across the quarry. In front of us was a great slope of broken chalk rocks that led up to the cliff face.

We had to climb the chalk cliff to reach the chalk face. It was very steep. We had to scramble up. It was difficult. Lots of us slipped down. It wasn't very safe. We got scratched from brambles, and stung by nettles. There were some cuts and bruises. But most of us got to the top of the slope and could start looking for fossils.

[We were accompanied by enough parents to put children into groups of four, each with a supervising adult. The quarry was stepped, so that children could fairly easily work on different strata.]

Some people went up to ledges and hammered there on the face. Others worked on the loose chalk. Nearly everyone found at least one, but a few found none at all. But hardly anyone really hurt themselves. We dug nearly a whole day, and brought back 97 rocks to display. I found one. There are probably millions more just waiting to be found at Pebblecombe quarry. Some people had been there before us, probably to do the same thing. I want to go there again some day.

Some people stayed at the bottom. That was where most of the fossils were found. Some of us climbed only a bit up, and hammered there. We only tapped the rocks lightly, then it would crack open. If you found a fossil in it, you had to put the fossils in a bag, with a piece of paper. On the paper we wrote our names and marked where we found the fossil.



[This seemed a practical way to keep track of what was found. The sheets, illustrated here, were prepared before we went with a sketch of the quarry.]

The whole quarry was about 100 feet tall. It had two chalk faces, and some steep slopes – at least 40 degrees steep. When you looked down from the second chalk face it is so scarey that you almost fall! When you climbed a slope it was really tough and slippery.

Sorting and identifying the fossils

[When we returned to school we began the task of sorting and identifying the fossils we had found. Each rock was given a number for the purposes of identification. Many rocks had more than one fossil in them. These are some of the conclusions the children came to.]

One of the most common fossils we found was Inoceramus. An Inoceramus is a shell fish, and the shell is not symmetrical. This means that each shell is not balanced, not the same on the left as on the right. But the Inoceramus had two shells, and these are mirrors of each other. The Inoceramus was connected to the bottom of the sea by a muscle foot that held the shells together. This rotted away very quickly, so you wouldn't usually find an Inoceramus with two shells still together, because when the Inoceramus died the hinge broke.

One of the least common fossils were round cylinders. They are called Belemnitella. A Belemnite was a kind of squid, and it does not live now-a-days. We found two little bits of the hard shells of the bodies. At the end of the shell part there was a point. At the other end was the head, where there were tentacles and two eyes. It ate little fish with its tentacles. When it died all the soft bits rotted away. Only the hard case is found. Belemnites were thought to be the remains of thunderbolts before people knew about fossils.

Entolium is a shell fish, with shells in the shape of a balloon. It is in the same family as Inoceramus, but is smaller, and the curves are smoother and closer together. There are two shells with the animal in between. The shells are not symmetrical. They are different on each side. But the shells are mirror images of each other. The animal could swim in the water and was not fixed to the bottom like Inoceramus. They clapped their shells together and the water squirted out so they moved.

A Micraster is another kind of fossil. It is a sea urchin. They are in the family of Echinoderms. They were round, and had tube feet and spikes on the front and back. Their tubed feet were to stick them to the sea bed. The fossil is heart shaped. We found only one micraster in the quarry.

Rhynchonella fossils were very different from the other shells because a Rhynchonella has two shells stuck together. This was because the muscle which held the two shells together was quite strong and did not rot very easily. A rhynchonella is the shape of a triangle. The ribs stick out at the side. They lived on the seabed. The two shells of the Rhynchonella are not the same size. One is bigger than the other, and a different shape. But each shell is symmetrical, which is one way to tell the difference between it and Inoceramus and Entolium.

There were lots of fossils that we couldn't name. Usually they were small broken off bits, and it was difficult to see enough of them to know what it was. Probably most of them were Inoceramus, because that was the most common shell we found. Also we know that Inoceramus shells seemed to break very easily.

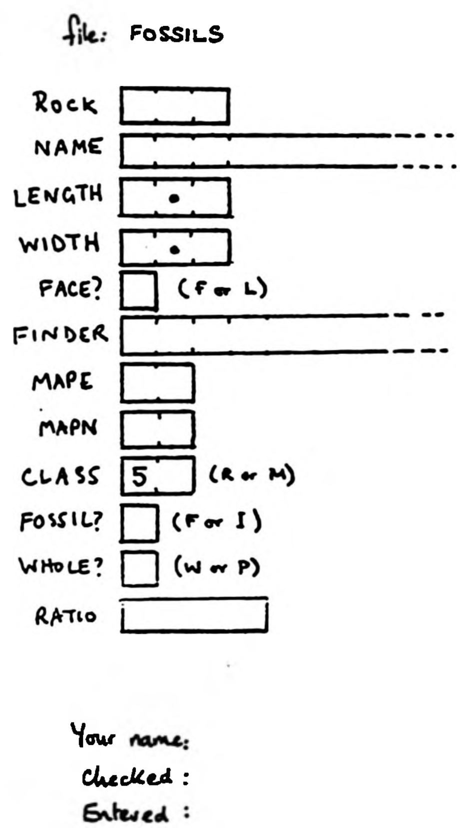
We wondered where most of the fossils were found. Most of them seemed to be from the bottom, because this was where it was easiest to look for them.

Only a few of the fossils were found on the top slope. There was less space up here, and not so many broken rocks. Also the chalk face was very narrow, just under the grass at the top.

Using the microcomputer

So that we could sort out the fossils quicker, we used the microcomputer to do some sorting for us.

First we made notes about all the fossils. We measured them, their length and their width. We wrote all the information down on a yellow sheet like this:



Also on the sheet we wrote who found the fossil, which rock it was part of, what we thought it was called, and if it was found on the face or was a piece of loose rock. We worked out where it was found and wrote the coordinates down for its position.

When we had finished we had details on sheets for 148 different fossils. All the information was part of a big table about the fossils.

On the computer we made a file about all the information, called FOSSILS. First we typed on the computer

MAKE FILE, FOSSILS

After that we typed in the field names that we had chosen.

[The file was constructed by the whole class, taking it in turns to add various bits of information. The file structure was as follows:

File name: FOSSILS
Description: Fossils found at Pebblecombe Quarry
Number of fields: 11
Number of records: 148

Fieldname	Length	Type	Notes
Rock	3	N	number of rock
Name	15	A	name of fossil
Length	3	N	length of fossil (cms) with a decimal point
Width	3	N	width of fossil (cms) " "
Face?	1	A	was the fossil found on the rock face (F) or loose (L)
Finder	10	A	name of finder
MapE	2	N	East coordinate for location of fossil
MapN	2	N	North coordinate for location of fossil
Class	2	A	Class of finder (5M or 5R)
Fossil?	1	A	was it an actual fossil (F) or an impression (I)
Whole?	1	A	was the fossil whole (W) or only a part (P)

The class were using the graphics/data-handling package DATAPROBE, developed by the class teacher with Malcolm Hall, and available from Addison Wesley Computing. The graphic print outs accompanying this article were all produced by the class using this system.]

When we'd finished [constructing the file] we typed the information into the computer. [148 records, one for each fossil, were thus entered into the file called FOSSILS.] We took it in turns to type in about two fossils each.

Investigating the data

[The class were divided into groups of four or five. Each group took on a particular task of analysis, using the computer to look for particular characteristics in the fossils. Each group made a number of predictions about what they expected to find: then they used the micro-computer to test these predictions.]

We then used the computer to sort out all the fossils as we wanted. Sometimes we had them all put on a list. This list is of all the fossils that were whole, and not in bits. We typed

ENQUIRE FOSSILS, WHOLE?=W

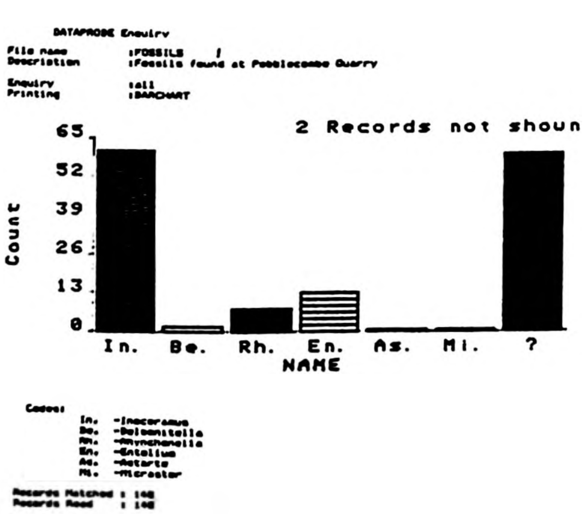
to find this.

```
Enquiry          :whole~=W
Printing         :LIST
Fields           :NAME
Sort fields
                 :NAME

NAME
-----------------------------------

?
-
Astarte
Entolium
Entolium
Entolium
Entolium
Entolium
Entolium
Entolium
Flint
Inoceramus
Inoceramus
Inoceramus
Inoceramus
Inoceramus
Inoceramus
Inoceramus
Inoceramus
Inoceramus
Inoceramus
Inoceramus
Rhynchonella
Rhynchonella
Rhynchonella
Rhynchonella
Rhynchonella
Rhynchonella
-----------------------------------
Records Matched : 29
Records Read    : 148
```

We could show the results as barcharts or piecharts as well as lists.



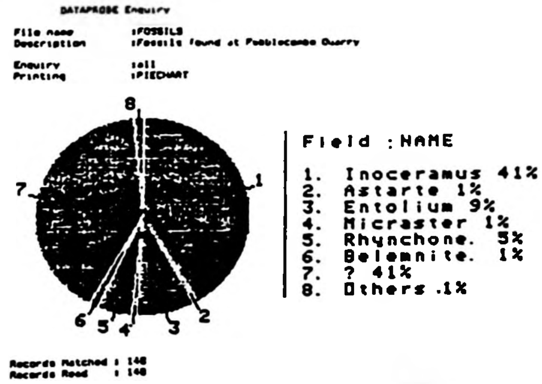
When we ask a question, there is some writing at the bottom of the screen that says "Command:"
We wrote next to it

EN	which means make an enquiry [An abbreviation: ENQUIRE will also work]
FOSSILS,	which meant into the file called Fossils, and
ALL	which means find all records.

Then it says "Command:" again, and we write how we want the results to be shown.

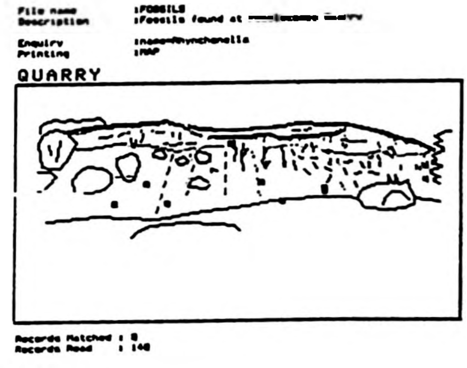
SHOW	please show
BARCHART	a barchart. Then the computer asks us for
Fieldname:	NAME which means make a barchart of the fossil names

Number of bars: 7 because we wanted seven bars, and each was to be called
Value for bar 1: INOCERAMUS
Value for bar 2: BELEMNITELLA
and so on.

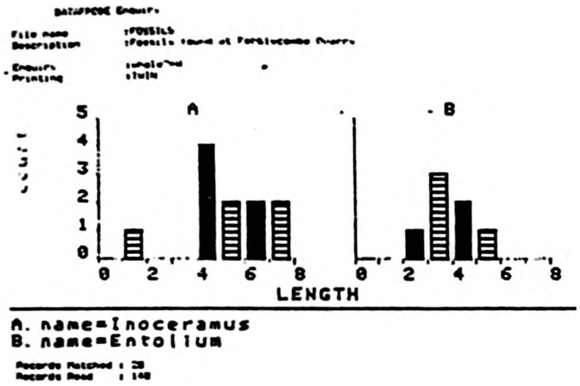


We could show the fossil names on a piechart, too.

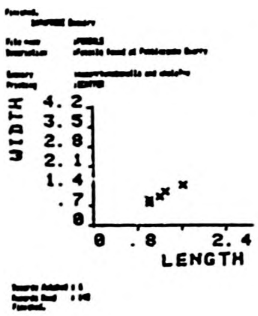
We could also get the computer to draw a picture of the quarry and put on it a little mark where each of the fossils we were interested in were found. This picture shows where all the Rhynchonella were found.

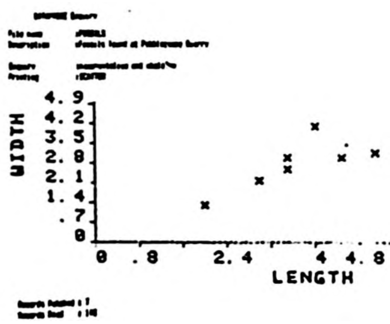


[To achieve this, the class teacher had first prepared a picture (given the name QUARRY) of the quarry on the screen, using the program to trace from a sketch of the quarry on acetate. A grid was fixed on to this, that corresponded to the coordinates used to plot the location of the individual fossils. To show this particular display, the children typed:
ENQUIRE FOSSILS, NAME=INOCERAMUS
SHOW MAP, QUARRY, MAPE, MAPN
The picture or "map" was then drawn and the points plotted.]

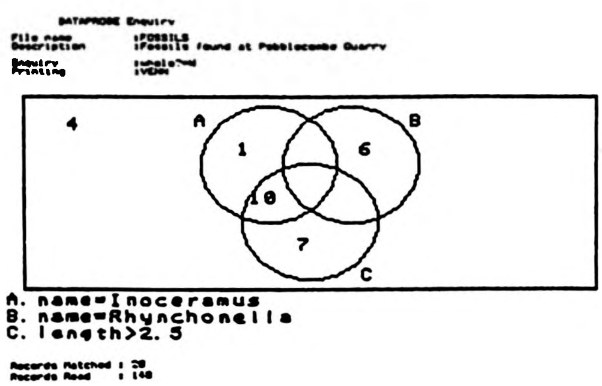


We looked at the different sizes of different kinds of fossil. Of course, we could only look at fossils that were whole. These two histograms are called a "TWIN". The first one shows that Inoceramuses were mostly over 4 cms long, and up to 8 cms long. The second one shows that Entoliums were smaller, mostly less than 4 cms.





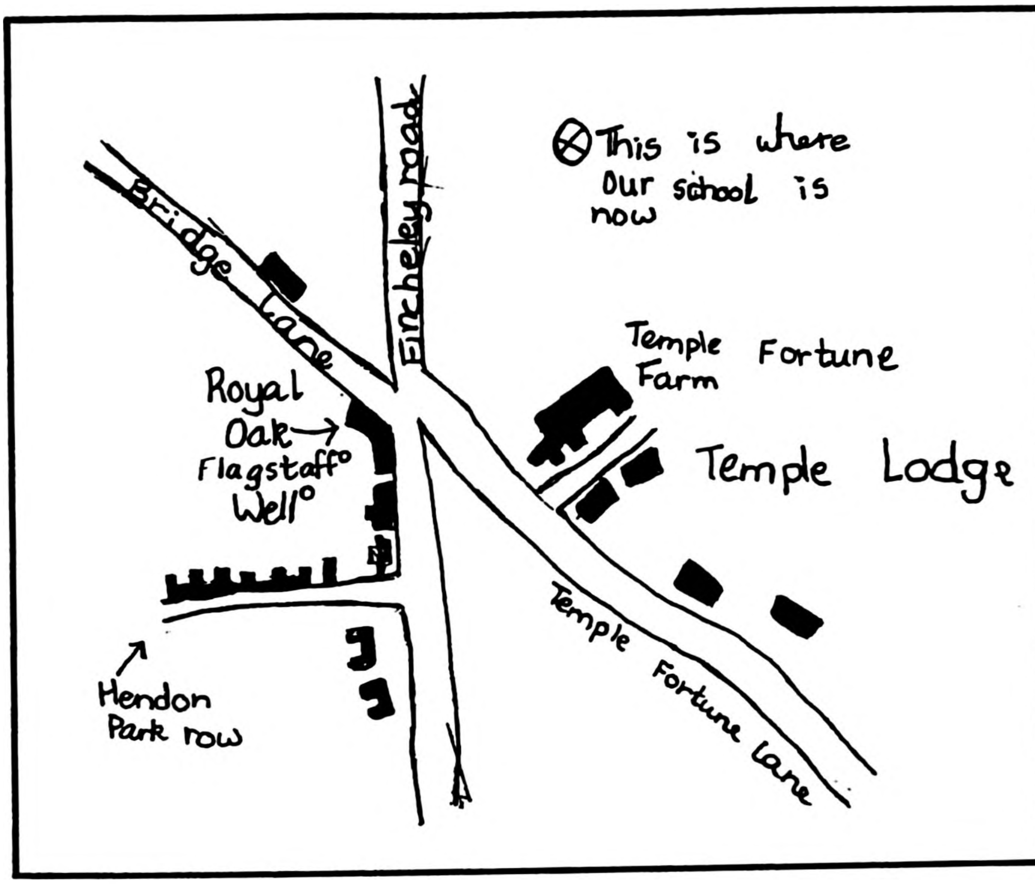
Here are two scatter graphs to show the length and widths of two different fossils. The Rhynchonella were all very small. The Entoliums were bigger, except for one which was about the same size as the Rhynchonellas.



[This final display, of a Venn diagram, needs some more careful explanation! Only the whole fossils have been plotted (see the list of these above). In the set marked A are the 11 Inoceramus: 10 of which are also in set C, that is, over 2.5 cms long. Set B is of the Rhynchonella: all six of these are less than 2.5 cms long. Eleven other fossils were also shown (that is, fossils that were neither Inoceramus or Rhynchonella. Seven of these were over 2.5 cms, and four less than this. To achieve this display, all that had to be typed (after the initial enquiry, WHOLE?=W) was the display type, the number of sets to be shown, and the definition of each set:

SHOW VENN, 3, name = Inoceramus, name = Rhynchonella,length>2.5]

Mohamed Abu-Taleb; Miriam Alkashi; Julia Bolger; Tsion Belew; Michael Feilding; Abigail Fitzsimmons; Eva Foulkes; Naomi Gangadeen; Angela Gerrard; Cathy Gomez; Hannah Liby; Sacha Ivanisevic; Tom Lavander; Nicholes Lim; Jeremy Logan; Philip Lythell; Ben McFarland; Leonard Mattos; Josephine Oliver; Celeste Pattaralowha; Sean Penfold; Jake Ryan; Harriot Stephans; Philip Wright; Aaron Czechowski; Mohammed Ghayouba; Casee Wilson.



Temple Fortune Using Quest with 8-9 Year Olds by Sharon Harrison

Garden Suburb JM School

This article first appeared in Chiltern Primary No 5, 1984, Chiltern MEP, and is reproduced with permission.

According to the curriculum structure of our school, one of the areas of study set for my 2nd year junior class is the Victorian era. Since we were therefore, "looking at life one hundred years ago" it seemed ideal to base the study on the 1881 census data for the locality.

My only previous experience of using QUESTD was with 3rd year juniors during their field study of trees in the summer term. I was a little anxious as to how my class would cope with the program, because most of them were only 8 years old. Since they had little experience in using the computer and I felt they needed an introduction to the idea of information handling, we started off by investigating the "Dino" file with Factfile. We then went on to set up our own class file on measurements etc. I had expected them to get bored with the "Dino" file quite quickly, but not so – it exploded into a "micro-project" (oops!) and for a week the classroom was flooded with dinosaur material. The children had no difficulty in handling Factfile, but were soon frustrated by its limitations. They couldn't ask it the questions they wanted to ask.

When I first introduced QUESTD to the class we looked at the Datchworth file for 1881. Initially we skipped through the file looking at just a few records in detail. I was amazed at the speed with which the children decoded the field-names, and formed hypotheses, for example: to explain why the household size and family size were sometimes different. We started off with the simply query structure "QUERY fieldname SUB value". The children found this easy to use and understand; they did not find the need for more specific queries for alphabetic fields. Later on they made queries involving "equal to", "greater than" and "less than" functions on numeric fields.

After a week of looking at the Datchworth data we discussed census collecting in more detail. The children became very excited at the idea of investigating the corresponding data for our area when we looked at the photocopies of the original census returns (which had been mounted on card and covered). Before looking at the QUEST data-file we went on an exploration of the locality, armed with copies of the 1880 OS maps, searching for traces of Victorian life. To our disappointment nothing remained except for the street names and the pub – which had been rebuilt in the 1920's. However, the children were very philosophical about our "failure" to find any remains of Victorian buildings, and started discussing when the Victorian building would have been replaced. When we returned to school they were very keen to find out who had lived in the different streets despite not having specific buildings to link the people with. After the initial query "Who lived in the pub?", most lines of investigation started with searches for people on the file with the same names or ages as the children.

In order to give a flavour of the way the class used QUEST, here are a few anecdotes:

One group found that two nine year olds on the file lived at the same address but had different surnames. This puzzled the children but they soon came with suggestions to explain the mystery: "They might have been living at a school", "They might have been cousins". In order to test their hypotheses the group decided to find out who else lived at that address. The mystery was solved – to their surprise two families lived in the same house! After further examination of the records the children found that both heads of the familes were farm-labourers and since they knew from the 1880 map that there was a farm "just down the road", they speculated that this would have been where the two labourers worked.

A child who is not the easiest to motivate was enthralled when she discovered a family with the same surname as herself. With the printout of the details she produced a family tree, which she was then able to compare with her own.

Although I had planned a visit to the graveyard, a suggestion to do so came, unprompted, from one of the girls when they were thinking of ways to gather more information about our Victorian people. When we did visit the graveyard, there was much excitement when we found what was probably the grave of the census enumerator!

Some fruitful investigations arose from quite random initial queries. One child decided to print out the details of all the heads of the families. After examining the list, he became interested in their ages, and looked for the "most common" age group. With a few helpful suggestions from myself and his peers, he planned to produce a block graph of specific age bands. At this stage I wished that QUESTD had the sorting and chart-drawing facilities available for the 480Z.

Conclusions:

The above are a few examples of the different types of investigations made by the children, which involved them in a good deal of discussion and some clear, logical thinking.

My initial reservations about the children being too young to cope with the program have been totally dispelled. Older children would probably make more extensive and sustained investigations, but I am convinced of the value of using QUEST as a core for a project with this age group.

We are lucky to have a printer at school. I would not have liked to attempt the project without it. Being able to print out their findings and have something concrete to keep was important to the children. Furthermore, it would have been very difficult to spot interesting connections and make comparisons merely with the screen display.

All of the class were involved in using QUEST except for a small group who have language difficulties and whose immediate cultural background is not British. In a school where the majority of children are from non-British cultures a project of this nature might be inappropriate.

The major drawback in using QUESTD was its speed, or more specifically the lack of it, in searching the data. The children sometimes became bored with waiting for the machine to deliver the results of their query. Perhaps it says something about the power of "information handling" that they did not lose interest in the project due to this.

There is still great enthusiasm for the project, despite all the end-of-term and Christmas chaos which has displaced "real work". The class is going on a 4-day field-study to a village in Kent next term. Provided I manage to type in the data-file, we will look at the corresponding census records for that village during the visit. I'm looking forward to seeing what comparisons the children come up with. Perhaps QUESTD will be in machine-code and faster by then.

Sharon Harrison
Garden Suburb JM School

Equipment:

Hardware – BBC B disk drive, Epson FX80 printer.
Software – QUESTD
Materials – Census returns for Temple Fortune, Middx. 1881 (good photo-copies obtained from Public Records Office, Kew). Maps and street directories photocopied from Local History Library.
Organisation – Micro in corner of class, groups of 3, sometimes 2, children.

In 1881 there was a farm called Temple Fortune Farm but now it's not there, it's a tennis club. Mrs Harrison's group first went to Farm Walk then we walked down Temple Fortune Lane and wrote down the name of Temple Fortune Court. Then we Looked at the Royal Oak we guessed it would of been a 'pub' in 1881. Then we went down Park Row we saw there was a butcher in Park Row now and a garage. We also saw a Substation. Then we went back to the Royal Oak and found out it was rebuilt in 1923. Timothy and I traced over the sign that told us it was rebuilt in 1923. We could not find anything that was there in 1881.

By
Gilad Segal

Data Handing using Editor, Display, Relate (and QUEST) in the Primary School

by Joe Johnson

Headteacher, Stadhampton Primary School

This article first appeared in Chiltern Primary No 5, 1984, and is reproduced with permission.

These four programs together form a versatile tool for the exploration and understanding of information by primary school children. Using them, children can manipulate information in all sorts of ways and then make a printer copy for further discussion and analysis.

Stadhampton school is a small rural school about five miles south of the Cowley car factories. The school is housed in a modern building in over three acres of land. We have two members of staff and 41 children on roll.

My School received its DOI 480Z Micro computer at the end of November 1982. We bought an Epson printer in May of 1983 and this purchase opened up many new possibilities of working with the micro. Using EDITOR and QUEST, data files can be constructed and I have found that children are able to use EDITOR very easily without assistance or supervision. QUEST is not so accessible to children and I will not discuss the use of QUEST in detail as an end in itself but rather the use of QUEST data files with DISPLAY in particular. I shall first of all show the "menus" of these programs (excluding QUEST) and then focus back to my children's explorations outlining some specific topic based work undertaken over the past year and a half where these computer programs have been an integral part of the resources for learning in the school. Central to my work has been the idea that this type of work should lead to children understanding what they are doing. My usual phrase for this is "getting behind the figures".

Measuring Topic

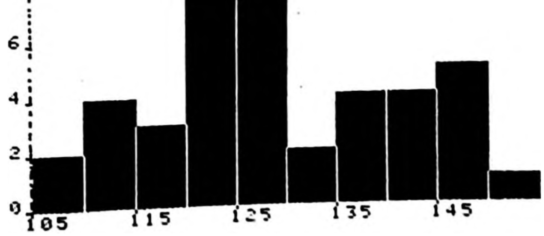
In January 1983 the children began this topic by measuring their height, weight, hand span and foot length. They each combined all results for their year group into a table showing all their names and measurements. The children went on to measure all the children in the younger class. This information was then handled in different ways. Graphs and histograms were drawn and labelled. Ordered lists were made and some older children made pie charts. As part of this general work three fourth year girls used the computer. First of all they prepared the information to be entered into the computer. I showed them how to operate the EDITOR program, although at that stage they really had little idea of what was to happen to the information once it had been typed in.

They worked very hard typing in the information which magically became "data" and I spent part of the lunch break correcting one or two obvious errors in the data file ready for the children to use in the afternoon. We loaded DISPLAY and then our datafile which the children had called "School". The children discussed what to display and they decided to display the heights and ran into their first problem. The computer could not handle a huge number of separate columns and lumped single entries together as others. Obviously this was not very satisfactory and the same thing happened with the pie chart.

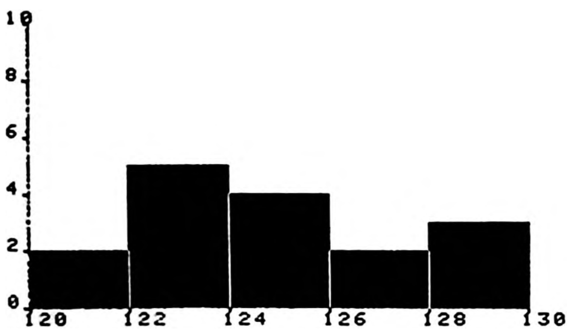
We had already done some grouping of information in our work in the classroom and so the children went back and rewrote the information, grouping it where it was appropriate. Now the children had a table of measurements arranged in a particular way especially for the computer. Not an ideal situation but improvements in the software, which would enable children to group the information, were three months ways.

The arrival of our printer coincided with the arrival of a new version of DISPLAY and a trial version of a new program, RELATE. The new version of DISPLAY could put the data into different groups which were under the control of the children. There was still no printer option within the program but I asked and got the magic words to do high resolution dumps from the screen to the printer. The children could then copy the words from the screen onto their bar chart, histogram or pie chart outline. We could now print two different bar charts and compare them directly. I now decided to collect the same measurements as the term before with a longer term view of collecting this information every term, which would eventually enable older children to draw profiles of different aspects of their own growth.

With the new hardware and software, I brought the three fourth year girls back to the computer and let them re-examine their "School" datafile and print off several bar charts, histograms and pie charts. The children immediately appreciated the new facility in the DISPLAY program + "put the data into groups" as they were spared the need to do the grouping on paper. They could now alter the number and width of the groups and they talked excitedly as they explored together, this new dimension in their learning. The conversation of that small group was reward enough: What would happen if I did this? How was that one different from the last one? The shape is different, – why? The children were making hypotheses then testing them and because they had the courage to verbalise with each other and build on each other's thoughts and ideas. They were immersed in this activity for some time.

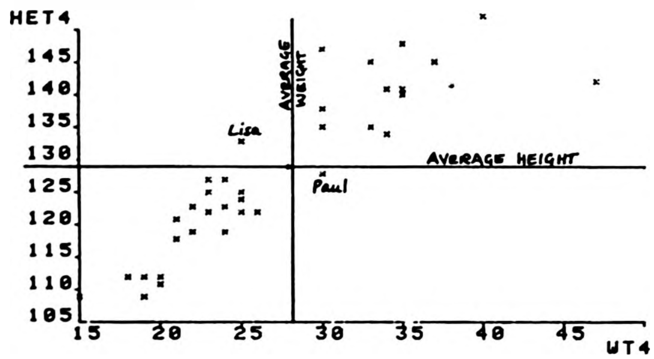


Here the groupings have been changed to five centimetres.



In this printout only part of the information was selected and shows the numbers of children between 120 and 130 centimetres in 2 centimetre groups.

The new set of data was added to the first file and we discovered several inaccurate measurements which the children had made the previous term. How could a child's handspan decrease by four centimetres in a term? Human error was the answer! This group also dabbled with RELATE and printed off a few scattergrams showing relationships between height and weight and combining lines showing averages, again noted down from DISPLAY. They could make a short statement about different children as represented by dots on the scattergram. For example: Paul is below average height and above average weight. Lisa is above average height and below average weight. Paul, as you might surmise, is rather thickset and Lisa is tall and slim.



This scattergram made using RELATE compares heights and weights of children in the school. I have drawn in lines showing the averages for both and marked the crosses which represent Lisa and Paul's measurements.

Several other children were interested in the activity around the computer and later on the girls passed on some of their skills in using DISPLAY to other children in the class by 'piggy back' learning.

The computer did bring something new to this situation. It made it possible for the children to see the information organised in a variety of ways under their control, quickly! Using the computer meant that they were free from the physical chore of using paper, pencils, ruler and pen. They could concentrate on thinking about the information.

Final improvements to the programs enabled the children to print their information with ease. The children now keep a record of their measurements each term and this information will be a valuable resource for future work.

Youth Club Survey

In the Autumn term of 1983, I used our data handling programs to interpret a survey which our Parent Teacher Association organised at the fortnightly Youth Club which they run for our children at the school. They wanted feedback on what activities the children wanted or liked at the club. I entered the answers to the ten questions of the survey into a QUEST datafile.

A group of second year junior children then used DISPLAY to print out pie charts showing the answers to the straight forward yes/no questions. The children coloured the pie charts in with different colours and then carefully wrote a description of what the pie chart was about for example.

Once the pie charts had been completed they were compared and this sparked off more discussion amongst the second year group. At the following Tuesday Club they were displayed and discussed and conclusions were arrived at. Some changes were made in the Tuesday Club activities as a result of the survey and this was mainly as a result of the way that the survey was presented and the involvement of a group of children in preparing and interpreting the results.

The children involved in this activity were not able to construct accurate pie charts of their own but they did grasp the slice of cake concept of the pie chart and were able to interpret the information.

Some further comments are worthy of mention. Look for opportunities in your work with children to use this resource and actively collect information which may be useful in the future (local history, weather records etc.). Seek depth of understanding for a few rather than a shallow awareness for all. This will mean giving a few children more than their fair share of computer time. The data in use must have a relevance and interest to the child. The computer in this context is a machine to facilitate a closer and deeper understanding of the meaning and significance of information but using the computer is only one part of that process.

Some ideas for using databases to study local traffic by Mike Archer,

Manchester Polytechnic

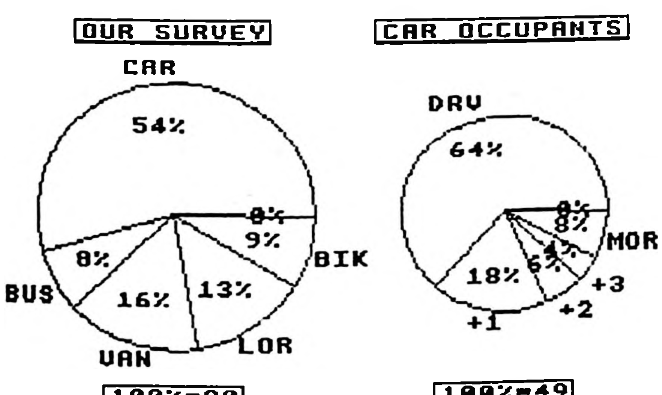
One of the potentially more exciting developments associated with the advent of microcomputers into the primary school has been the growing availability of information free data handling packages such as FACTFILE, DATAPROBE, SCAN, and QUEST. The value of these packages lies, in part, in their ability to store large quantities of data and process it rapidly and accurately and, in the case of graphics programs, such as PICFILE or BEEBPLOT, to portray information in a variety of graphical forms. In addition the use of data processing packages by children provides a vital opportunity to nurture information handling and inquiry skills. The development of an investigation requires, inter alia, decisions about the sort of information that may be relevant, how it might be collected and how it might be categorised. These are activities that involve consideration of the attributes of information such as its accuracy, relevance and the bases and validity of classifications that may be employed. Use of the data, once it has been entered into the computer, requires consideration of the sorts and forms of questions to be asked, any hypotheses to be tested, the significance of any relationships uncovered, and, with a graphics program, the most appropriate way to present the information or results obtained.

Where the computer is so valuable a tool is in the speed and accuracy with which questions can be answered and results be displayed. This not only frees children from the time consuming drudgery of much investigative work carried out in the absence of a computer but makes more time available for the more exciting business of investigating the information in the search for relationships and pattern. The speed of analysis means that an increased range of possible relationships can be explored and much more information can be readily interrogated extending to data bases of related material that the children themselves have not necessarily collected.

Use in local area work

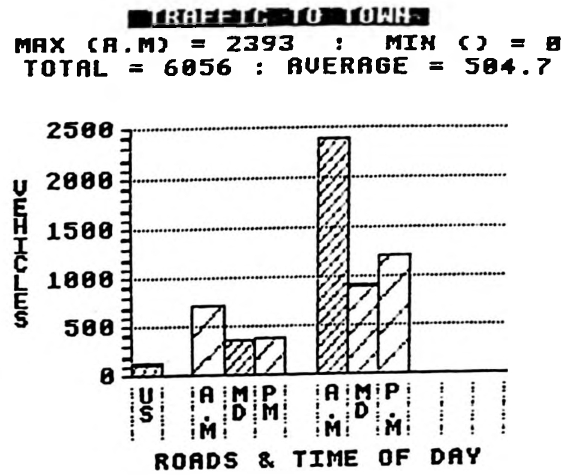
As briefly described above, data handling packages are of considerable potential value in local area work, work which frequently involves children in collecting relatively large amounts of information relating to the principle centre of interest. One topic often pursued in the primary school is the study of traffic. Set out below are some ideas, where the availability of a computer can not only enhance the sort of work that has conventionally been done, where traffic has been taken as a focus of interest, but can also open up new possibilities for investigation.

Most studies of traffic usually include a simple survey of the volume and categories of vehicles on a local main road and often extend to a survey of car occupancy levels. Where the computer can be an invaluable aid is in providing the facility, using a graphics programme such as BEEBPLOT, to display results quickly in the form of histograms or pie charts. (Diag. A) The option to display

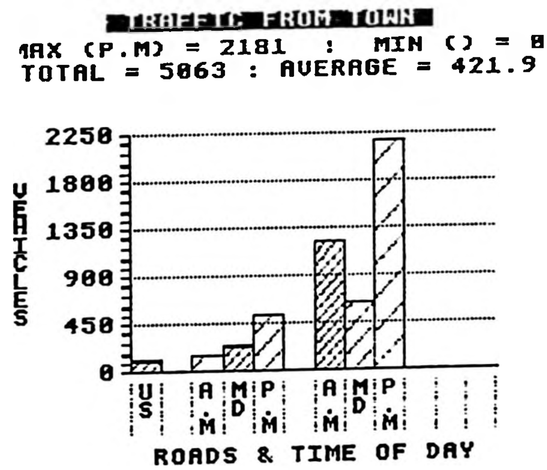


Diag. A

results of the childrens own work rapidly has the advantage of allowing the class to begin to explore the significance of their results soon after the survey has been carried out and whilst the initial interest in traffic is still likely to be high. By having available data on traffic flows at peak and off peak periods both for the road studied and for other main roads, which the children can display as histograms with the aid of the computer, allows comparisons to be easily made with their own results.



Diag. B_1

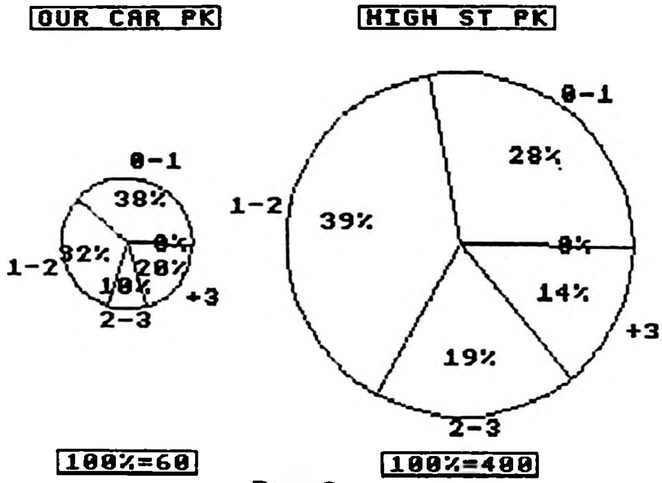


Diag. B_2

(Diags. B) Discussion can quickly lead into how far traffic volumes vary from road to road; possible reasons why traffic flows vary at different times of the day; why some roads are busier than others; why journeys are made etc. Data on traffic flows can usually be obtained from the local planning office in a form directly comparable with the children's own results.

Car Parking in the local area

Carparking in the local area is one aspect of traffic that can be of considerable interest to children. A preliminary survey of where vehicles park in the local school environment can lead to simple map work showing which roads are subject to parking restrictions; the location of official car parks and other off street carparking areas; and identification of particularly congested areas. This initial survey could include a simple count of the number of vehicles parked at the time of the survey. Off street carparks can be an especially worthwhile focus of interest. Discussion of carpark capacity might lead into an investigation of carpark usage by length of stay. How many cars use the car park on a particular day? How long do vehicles park for? Are the majority of spaces used for short term parking, associated possibly with shopping trips, or are some spaces occupied all day? With the aid of a data handling program able to sort information it is possible to carry out a simple investigation to answer such questions. By collecting registration numbers of parked vehicles at hourly intervals information can be easily collected by several groups of children for entry into a simple data base containing information on the time of the survey and vehicle registration details. By sorting the registration field into alphabetical order it is easy for the



Diag. C

children to calculate the relative numbers of short and long stay vehicles. As before, the results can be easily displayed in the form of a pie chart (Diag. C). The results and ensuing discussion of their significance might well prompt a further investigation, via a questionnaire, into other aspects of car park usage. As with all surveys the children should be actively involved in deciding on what information should be collected and the most appropriate design for the questionnaire. A simple survey might include:-

Date of survey .... Carried out by ....
Time .... Weather ....

1) Driver: Male/female
2) How long do you expect to leave your vehicle?
   - 15 minutes
   - 30 minutes
   - 1 hour
   - Longer than 1 hour
3) What is the purpose of your visit?
   - a) to shop
   - b) to go to work
   - c) visit the library
   - d) deliver goods
   - e) business call
   - f) other
4) How far away do you live?
   - less than 1 mile
   - 1 to 2 miles
   - 2 to 3 miles
   - further than three miles
5) Would you be prepared to pay to park?
   - Yes/No
   - If "yes", would you be prepared to pay:-
   - 5p
   - 10p
   - 20p
   - more than 20p

Once the results of the survey are entered on the data base, investigation can begin. Even as simple a survey as that suggested here would yield, amongst many possibilities, information on the reasons why journeys are made; the distance over which people travel to use local facilities; whether there is any relationship between the main purpose of a journey and the length of stay; whether different types of journey purpose draw people from different average distances; the extent of the local shopping catchment area; whether or not people would be prepared to pay to park and if so how much on average. The availability of a graphics programme again can be employed to display the results quickly and accurately.

Comparisons with city centre car park

Familiarity with local carparking conditions might then be used as a springboard to consider patterns in parking further afield. For example comparison of the local car park with a multi storey city centre car park would reveal some interesting points of similarity and contrast. It may be possible to obtain data from the local planning department and create a data base for the children to investigate. Discussion, informed by the study of the local car park, might well yield a range of hypotheses to be tested: some days of the week or months of the year might be expected to be busier than others; investigation might throw up some unexpected anomalies - for example the Saturday before the start of the school term might be particularly busy. Perhaps Saturdays that showed an unusually low carparking level might be very wet and discourage shoppers. Perhaps the fact that the average length of stay on weekdays is shorter than on Saturdays might have some explanation. (Diags. D show aspects of carpark usage of central Manchester's High Street car park in 1983/84) The point to stress is that having worked on a data base generated from their own survey work children are better equipped to investigate other data bases; are more likely to be critical of possible limitations in the categories of data used; less likely to accept data on face value (was an unusually low level of

Diag. D_1. Busiest days in the year

DAY	DATE	TOTAL
TUE	1227	4042
SAT	0505	4105
SAT	0908	4211
SAT	0929	4247
SAT	0310	4268
SAT	1013	4324
SAT	0512	4367
SAT	0317	4405
SAT	0526	4448
SAT	0922	4553
SAT	0324	4641
SAT	0331	4649
SAT	1006	4833

Diag. D_2. Quietest days in the year

DAY	DATE	TOTAL
MON	0507	169
FRI	1019	1324
TUE	0320	1335
TUE	0508	1335
FRI	0921	1363
WED	0307	1432
TUE	0515	1443
THU	1011	1482
TUE	1009	1533
MON	0305	1543

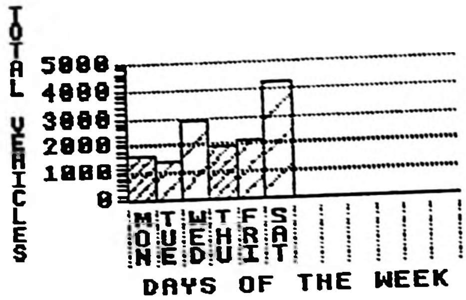
Diag. D_3. Pattern on a daily basis, week in July (also graphed).

DAY	DATE	TOTAL
MON	0305	1543
TUE	0306	1859
WED	0307	1432
THU	0308	2302
FRI	0309	1569
SAT	0310	4268

Diag. D_4

PARKING ONE WEEK JULY

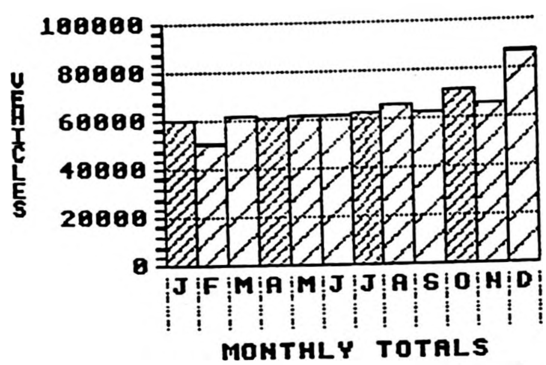
MAX (SAT) = 4241 : MIN ( ) = 0
TOTAL = 14145 : AVERAGE = 1179



Diag. D_5

PARKING 1983/84 HIGH ST

MAX (D) = 88886 : MIN (F) = 50496
TOTAL = 774219 : AVERAGE = 64520



carparking on a particular day due to a malfunction of the ticket machines?); and by virtue of the power of the computer in accessing information are able to ask more searching questions and get intelligible answers much more rapidly than would be possible in their absence.

Investigating through and stopping traffic

One particularly interesting possibility that the data handling capability of the computer opens up is the possibility of investigating the relative importance of through and stopping traffic in an area and the principal directions of movement of through traffic. (An investigation into this area might be prompted by a discussion of possible ways of reducing the volume of traffic on a local shopping street.) The basic method outlined below has frequently been used by secondary school children though in the absence of a computer it is an exercise that demands a considerable amount of time in processing the results. What is suggested here is that the data handling capabilities of the micro bring this sort of investigation within reach of junior school children.

The basic principle of a "cordon survey" is that survey points are established such that no vehicle can enter or leave the survey area without passing one or other of the survey stations. Groups of children are positioned either side of the road and record car registration letters (ignoring registration numbers greatly simplifies the recording task and does not materially affect results) for a period of up to twenty minutes. A census proforma might appear as set out below:

Census point .... Collected by ....
Inbound/outbound
Time Period Car registration
9.00-9.04 JND,WER,JKL,DFG,BVC,SDF
9.05-9.09 TPG,FVM,NBC,XZS,GHJ.

A data base can then be created using four fields: census point; time; inbound/outbound; car registration. By sorting the car registration field, any through traffic should appear twice, on successive lines. (Diag. E) recorded entering and leaving the survey area and, in each case, the screen listing will indicate the census points concerned. By omitting from the data base the first five minutes of outbound traffic and the last five minutes worth of inbound traffic, then it is reasonable to presume that any vehicle that only appears once in the listing is stopping traffic that had some particular and specific reason for being within the survey area. By investigating the data base the relative proportions of through and stopping traffic can be easily calculated. In addition by examining the census points of entry and exit for through traffic, it is relatively simple to pick out the main directions of movement of through traffic. These results can be shown in the form of a map which can then be investigated to see whether the volume of through traffic could be reduced by, for example, diverting some of the flow on to other roads.

Diag. E

CENSUS	DIRECT	TIME	REG
A	IN	[illegible]	[illegible]
A	IN	[illegible]	[illegible]
A	IN	[illegible]	[illegible]
[illegible]	OUT	[illegible]	[illegible]
A	IN	[illegible]	[illegible]
A	IN	[illegible]	[illegible]
A	IN	[illegible]	[illegible]
B	OUT	[illegible]	[illegible]
A	IN	[illegible]	[illegible]
B	OUT	[illegible]	NLH
A	IN	[illegible]	[illegible]
C	OUT	[illegible]	TRS
A	IN	9.05	VNT
C	OUT	9.10	VNT

The educational value of children being actively engaged in investigations of their immediate environment has been widely accepted in many schools. The availability of a micro can enhance and extend such investigations though it should be stressed that the use of the computer in local area work should be seen as a means to an end rather than an end in itself.

Seeing the Wood for the Trees: A review of some tree-structured data-bases and their uses

by Peter Hunter,

Support Teacher for Computer Education, Somerset.

Much of the information handling work that many schools are now undertaking involves the use of a data-base program which organises the information as a set (or file) of "records" (like index cards). In each of these records there are likely to be a number of different entries, each with a particular heading or "fieldname". Viewed as a whole, the complete file may be seen as a table of information (see Figure 1) with each record occupying a row and each field a column.

Fieldnames

SURNAME	FIRST NAME	SEX	AGE	HEIGHT
Ashton	Brian	M	24	172 cm
Collins	Susan	F	21	159 cm
Davies	Heather	F	31	161 cm
Moore	Michael	M	27	166 cm
Newman	Rebecca	F	25	167 cm

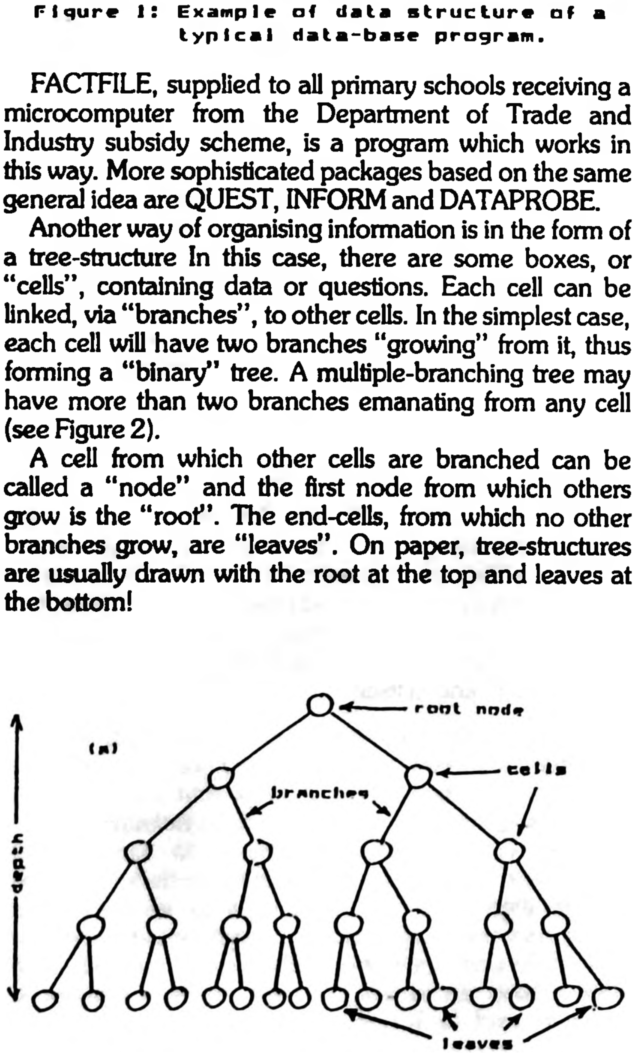
Records

Figure 1: Example of data structure of a typical data-base program.

FACTFILE, supplied to all primary schools receiving a microcomputer from the Department of Trade and Industry subsidy scheme, is a program which works in this way. More sophisticated packages based on the same general idea are QUEST, INFORM and DATAPROBE.

Another way of organising information is in the form of a tree-structure In this case, there are some boxes, or "cells", containing data or questions. Each cell can be linked, via "branches", to other cells. In the simplest case, each cell will have two branches "growing" from it, thus forming a "binary" tree. A multiple-branching tree may have more than two branches emanating from any cell (see Figure 2).

A cell from which other cells are branched can be called a "node" and the first node from which others grow is the "root". The end-cells, from which no other branches grow, are "leaves". On paper, tree-structures are usually drawn with the root at the top and leaves at the bottom!



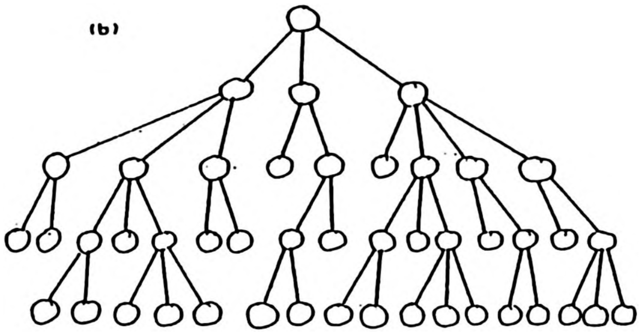


Figure 2: (a) Binary tree.
(b) Multi-branching tree. In this example, the number of branches from root to each leaf is not constant.

One program based on this idea is ANIMAL in Microprimer Pack 1. Using this, children can play a game in which the computer attempts to "guess" the name of an animal which they have chosen. It does this by asking a series of questions each of which demand either a "yes" or "no" answer. If the computer fails to identify the animal, the children must tell it and supply a new question with a yes/no answer. In this way a binary tree grows inside the computer's memory as each new animal is added to the data-base (see Figure 3).

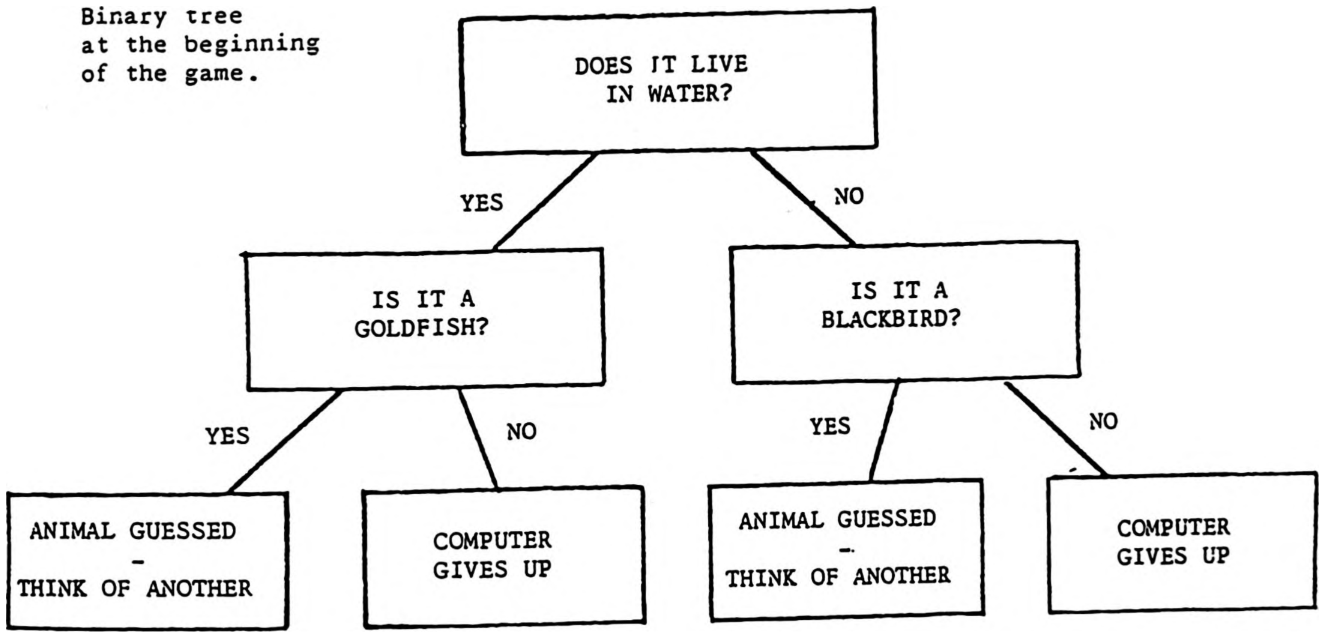
ANIMAL, of course, only concerns animals. Other programs (e.g. SEEK, BRANCH, TREE of KNOWLEDGE or ANIMAL, VEGETABLE, MINERAL) use this binary structure but are not subject-specific, i.e. files can be created by the children on any topic of their own choosing. In most cases, with a binary tree program, the two branches from each node correspond to "yes" or "no" answers to questions. SEEK is particularly useful in that it provides a visual display of the binary tree as it is used and is supported by the programs, INTREE and THINK, for the production and further exploration of files.[1]

A program which extends the scope from binary to multi-branching structures is DATATREE. This is a disc-based system which allows tree-structures on any subject to be created with up to 320 characters of text in any one cell, a possible 20 branches from any cell and a maximum of 255 cells in any file.

Other systems exist which are also tree-structured but perhaps less-obviously so. One example is Prestel's Viewdata system. Here, "pages" of information are accessed through a series of "menus", i.e. making a choice from the main menu will take the user along a branch to a sub-menu and thence to further sub-menus or information pages. Programs are available to "emulate" this process. Each of these will provide an "editor" for creating "teletext" pages and a display system for viewing them using the branching principle already described. Examples of such programs are EDFAX and MIKEFAX. DEETREE is another program which operates

"ANIMAL"

Binary tree at the beginning of the game.



Binary tree after addition of three more animals (whale, spider and lion) and three questions.

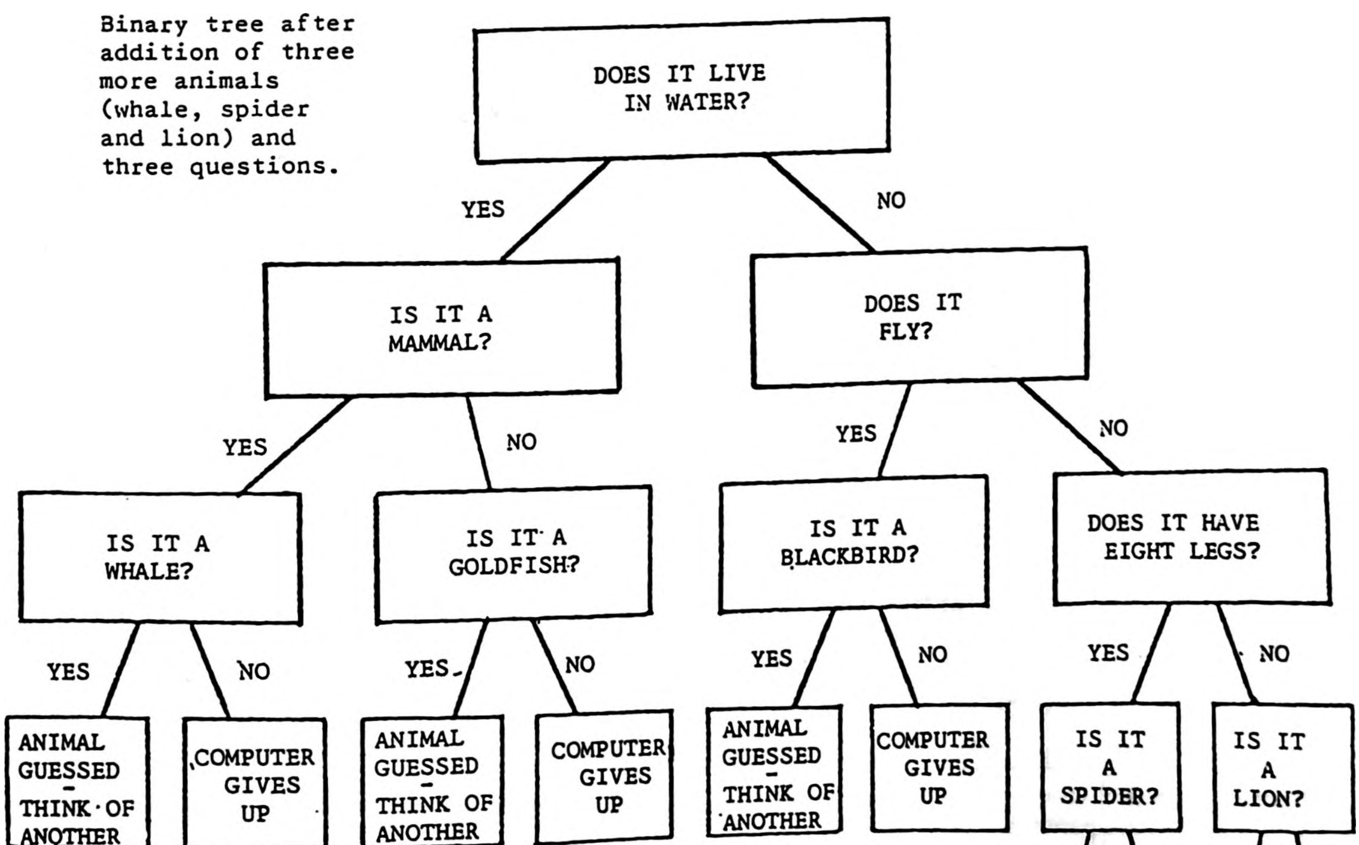


Fig. 3

as a Viewdata data-base. Its use for setting up a key, by which different species of trees might be identified, is described by Barry Wake.[2]

Why be concerned with tree-structures? For one reason, it is evident that the use of this type of program can stimulate some useful discussion and language work as well as provide the opportunity for the development of thinking skills. Daniel Chandler has written in a number of places about this with regard to the Animal Game and the use of TREE OF KNOWLEDGE[3], Jan Stewart has done the same in relation to SEEK[4] and Charles Bake has described the use of ANIMAL, VEGETABLE, MINERAL[5]. Discussion and thinking arise out of both using and extending an existing tree and also devising a fresh tree. In the more complex of cases the creation of a fresh tree requires detailed planning away from the computer and may also necessitate the production by children of writing, drawings, etc. as documentation to accompany their computer file.

Certain kinds of information clearly lend themselves to being incorporated in a tree-structured computer data-base. Identification keys (along the lines of the Oxford Clue Books[6], for example) have already been mentioned. Apart from the DEETREE key on trees, DATATREE is supplied with a key on the same subject and SEEK has been used for preparing keys on, amongst other things, slugs, powders, sedimentary rocks and electrical fault-finding.

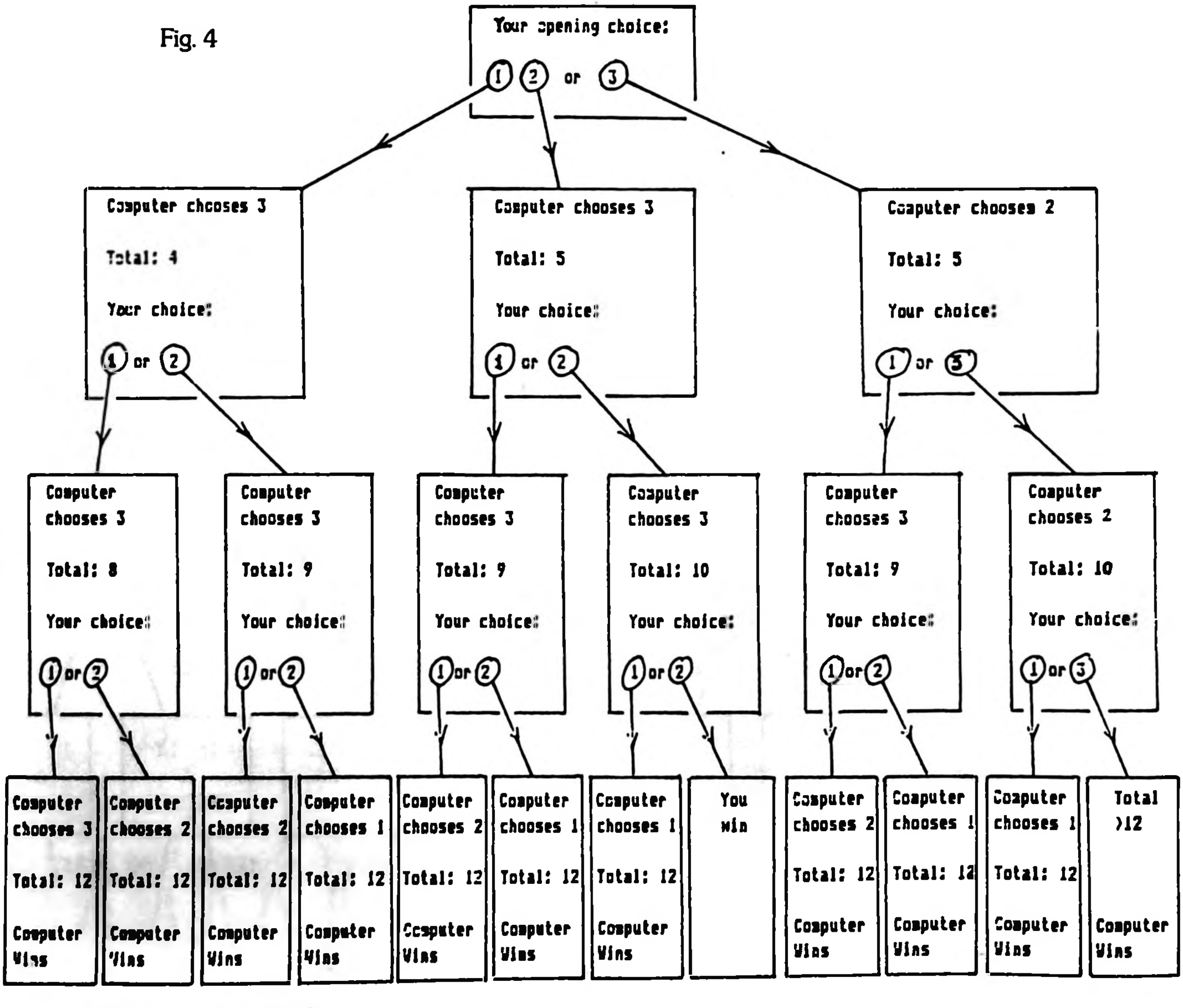
Family trees are another obvious possibility. A tree might be designed to replicate the questioning and elimination of suspects in the investigation of some fictitious crime. Also popular recently is the idea of a branching story in which the reader, at various junctures, can make decisions which influence the course of events in the story. In book form, such stories necessitate the "turning over" of several pages according to decisions made by the reader. With the computer this process is "hidden" and, perhaps, obtrudes less into the flow. TRACKS is a program which is specifically designed for children to make up their own branching stories although it is possible to do this with another, more general, tree-structured program (e.g. DATATREE).

Finally, tree-structured data-bases might be used to explore alternative strategies in simple games. It is possible in "turn-taking" games to map out all the possible lines of play as a tree. Noughts and crosses, for instance, is reasonably manageable although it may prove larger than expected. Draughts would be far too complicated, an estimated 10^{40} cells being needed!

To conclude, an example to consider: One of the programs written by Anita Straker (Director of the MEP Primary Project) provides a mathematical game called MAKE 37. In this game two players take it in turns to choose a number from the range, 1 to 5. Each time, the number chosen is added to a running total and the player next to choose is prohibited from choosing the last number used. Thus, for example, if player A chooses 4, player B may not choose 4 on the following go. A player wins if he is able to choose a number which makes the total 37 or forces his opponent to exceed 37.

To devise a tree for this game as it stands would be quite a sizeable task. A simplified version, however, could

Fig. 4



have a reduced choice of numbers (say, 1 to 3) and a lower target total (say, 12). It might be called "Make 12". The tree in this case is more manageable. Figure 4 shows one way of doing it.

Here, the computer acts as one player so that computer choices of number are fixed within the tree and the branches correspond to choices offered to the human opponent. As you can see, it is easy to "rig" this game so that the computer wins most of the time! A few adjustments and it may win all of the time! It is an illustration, however, of how the use of a tree-structure may help in understanding the strategic thinking involved in the playing of a simple game. The data in Figure 4 could be used to create a file for DATATREE, for instance, thus producing an (almost) unbeatable computer opponent. What would happen, though, with a different target total, a different range of choices or the computer going first? What happens in different games? These are all good questions for further investigation.

Notes:

1 For a description of SEEK, see, for example, Coupland, J.: "Software – an historical overview" in Chandler, D., ed. (1983) or Stewart, J.: "Vive les differences" in Govier, H. et al eds. (1984).
2 See Wake, B.: "DEETREE, a Viewdata database – a potted case history" in Govier, H. et al, eds. (1984).
3 See, for example, Chandler, D.: "Microcomputers and the English teacher" in Terry, C. (1984) and Chandler, D. (1984), pp. 13-19.
4 See Stewart, J.: op. cit. and Stewart, J.: "Does the use of the microcomputer inhibit the development of language in children?" in Chandler, D., ed. (1983).
5 See Bake, C.: "Two approaches to sorting information" in Govier, H. et al, eds. (1984).
6 See Allen, G. and Denslow, J. (1970).

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Terry, C., ed.: *Using Microcomputers in Schools*, Croom-Helm, Beckenham. 1984.

PROGRAMS IN THIS ARTICLE (all available for the BBC Model B Microcomputer unless stated):
ANIMAL: Microprimer Pack 1, Tecmedia, 5 Granby Street, Loughborough.
ANIMAL, VEGETABLE, MINERAL: Arnold-Wheaton Software, Parkside Lane, Leeds.
BRANCH (RML 480Z only): Oxfordshire L.E.A., Oxford.
DATA PROBE: Addison-Wesley, 53 Bedford Square, London.
DATATREE: CKS, 4 Hill View Close, West Chinnock, Crewkerne, Somerset.
DEETREE: MAPE Tape 2, Newman College, Bartley Green, Birmingham.
EDFAX: Tecmedia, 5 Granby Street, Loughborough.
FACTFILE: Cambridge Micro Software, Cambridge University Press, Cambridge.
INFORM: Nottinghamshire Computer Education Centre, Eaton Hall, Retford.
MAKE 37: Anita Straker, St. Mary Bourne, Andover.
MIKEFAX: Colin Rowling, 2 Tamar Road, Haydock, St. Helen's.
QUEST: A.U.C.B.E., Endymion Road, Hatfield.
SEEK, INTREE and THINK: Micros in the Primary Classroom Module 4, ITMA/Longmans, Tanner Row, York.
TRACKS: MEP Primary Language Pack, King Alfred's College, Winchester.
TREE of KNOWLEDGE: Acornsoft, Cambridge.

Can Data Handling help Children to form Concepts in the Humanities Subjects?

by Mary Hodges

Where teachers of humanities subjects see the computer as a tool to be used within subject areas in broadly the same way as computers are used in daily life, they are likely to focus on data and word processing. Programs like QUEST and QUESTD from Hatfield and BRANCH from Oxfordshire have placed in teachers' hands tools for data processing which can powerfully assist in the production of information and in the development of classificatory skills. Increasingly such programs are being used to process data collected by the children initially and then handled by the program to produce the information suggested by initial hypotheses. I have suggested elsewhere that there is no data like one's own data, in this article I hope to show why this is so.

Hilda Taba(1), Jerome Bruner(2), the Place Time and Society team(3), and others have tried to show that the humanities (or social sciences) for children require a structure dependent upon the formation of concepts. Such concepts should be the outcome of good curriculum schemes combined with well thought out learning sequences. Skills are seen to be essential, and the specification of skills to be acquired so that concepts can later emerge is the message conveyed by the curriculum plans developed by Taba and others. Learning is seen as 'bottom-up' or inductive in such schemes, so that in the end the child will be able to practice deductive thinking with the material acquired in an inductive learning scheme. However curriculum planners need a clear picture of what concepts should emerge and in what order as well as how skills can be developed in a sequence which relates to the child's stages of development. Concept based schemes in the humanities usually rest on systems devised in the social sciences, the "key concepts" suggested by the Place Time and Society team were communication, power, values and beliefs, conflict and consensus, continuity and change, similarity and difference, causes and consequences. These concepts should help teachers choose and organise actual topics in the classroom so as to allow work which will lead to an understanding of all the concepts. The skills to be practised in relation to the development of concepts is the other vital part of overall curriculum planning. Again the planning of skill development has been well covered by the Place Time and Society team.

Learning a concept

But the question remains – how can children "learn" a concept? If we consider concepts to be the gaps into which reality is fitted by progressive analysis and by progressive levels of abstraction, we may see "reality" as all the accumulated experiences which we gain as we learn. These experiences are to a certain extent organised in a planned curriculum in school, but much that we learn comes without the benefit of planning and has no sequence or coherence. I want to consider here dynamic thinking which is concerned with understanding structures which are changing or which are themselves dynamic. Much of the subject matter of the social sciences is like this since it is concerned with people. The key distinction here is between computational and combinatorial thinking. It was an insistance on the computer's facility for computational "thinking" only which led Lighthill(4) to rule out artificial intelligence as a sensible research area. He pointed out the apparent inability of any basically computational machine to manage combinatorial thinking. Yet Papert has laid great stress on the ways in which using programming languages such as LOGO and MICROPROLOG can assist children in developing combinatorial thinking and thus in developing concepts. Papert writes "Children may learn (in a computer-rich culture) to be systematic before they learn to be quantitative."(5)

What does this distinction mean? Surely children need to have computational and systems skills, but a fairly rigid acceptance of Piagetian stages seems to indicate that systems skills are unlikely to be learned before the "formal" stage of thinking has begun. This notion is of great importance in designing the curriculum for the humanities. The main aim of the humanities is to establish an understanding of the overall concepts which are seen to be difficult for anyone before the formal stage of thought. This leads those designing curriculum to downgrade such skills as data collection and organisation as being unconnected with concepts as the humanities teacher sees them. The sequence through which children should pass in order to analyse reality and from this analysis form the concepts is not well understood. Such a sequence could consist of the following steps. First collecting as many observable items as possible which together might add up to the reality needed in forming the concept. Here the teacher's planning is vital, she must make some decisions as to what she thinks counts as the data required. But some decisions can be made by the children as they discuss initially their own ideas about the subject matter as they see and understand it, too little time is normally spent on establishing what children already know or believe about the proposed topic. As the data is collected so connections can be made and links between items established. In discussing these connections non-observable items may emerge, ideas and approaches which may then be quantified in some way. At each stage the children and the teacher will be setting up – and knocking down – statements or hypotheses about what the data being collected means.

Collecting own Data

What is an hypotheses in this context? A provisional explanation or theory awaiting testing by the collection of more data? If so, then data collection within a humanities based topic will be of key importance in helping children develop the concepts desired by the curriculum planner. But they must have time to do it – and this is what is often denied. Why? Because many teachers still see the usual humanities topics as being areas where "facts" exist and are to be learned and from these learned facts concept formation will emerge. I would wish to propose that the usual humanities topic is in fact a dynamic area for learning where the facts are constantly shifting and the interest of the topic lies principally in collecting fresh data from which theories can be tested and concepts then developed. Does this mean that I would not lay down a preliminary ground work of known information (i.e. already processed data) upon which the topic can be built? This is the material books, programmes on TV or radio, teacher's own lessons and other sources provide. Children's "research" is often conducted into these already processed areas – and is none the worse for that. But the key distinction remains – we also need if we are to form the final concepts the chance to collect our own data to test our own theories, and this information processed from our own data is likely to be the most vivid and well understood.

If children are to do this they will have to handle real data, decide where to get it and how to collect it (questionnaires, forms etc) how to validate it when they have collected it, and how to process it into information which they can use within the topic.

This is much more than we normally ask them to do. "Copying out of a book" is what all too often actually happens. How can using the computer be different? Because if we force the issue of the sequence of finding the data, arranging it (using a database to help) and then deciding the output of information (again using a database to help) we have gone beyond what most children manage in relation to a text in a book. Ideally they would do what you and I do – read a lot of books and articles, listen to a lot of ideas, and then process these into a further text. But this is the most difficult challenge of all. Why should preparing data for the computer to process into information be any easier? Well, it is not easier but it can be presented, through structured databases, as a task with steps which children can follow one by one. Only some children will be able to follow through the whole process making every decision at every step. Most will need their teacher's help in planning the steps but they will in many, even most, cases be able to follow through the steps, as they work through the sequence of data into information via process. Job satisfaction seems to be enhanced by the fact that the information processed can be printed to a high standard. The results of work done in collecting data, especially where graphics are used, looks so professional. The pleasure this brings is comparable with the pleasure word processing brings to the production of text.

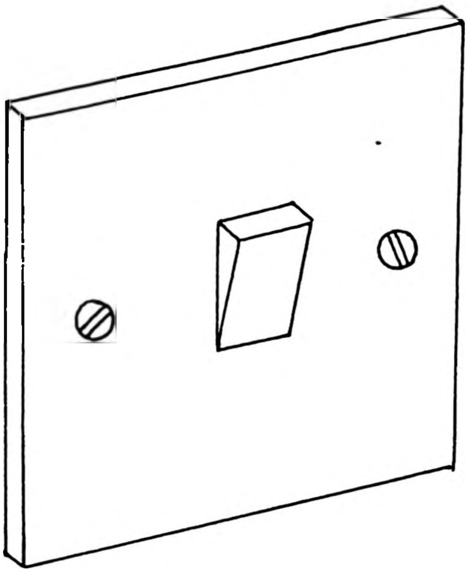
Is it true that the more data we have in an area the more likely we are to be able to form a concept? Concepts operate at increasing levels of abstraction, for children up to the age of about 13-15 in humanities topics the level of abstraction may not rise above that where the detailed data is readily identifiable with the concept itself. The collection of data and processing this into information about a given topic constitutes the vital step of accumulating experiences from which we create our own internalised models or concepts of the world. Bruner insisted that understanding (i.e. understanding concepts) comes from understanding structure. We build this understanding from experiences not from deductive reasoning. The fact that the computer is using such logical programming has no bearing on the fact that we as consumers will use it to feed our understanding by enriching our experiences. But there is a problem in all databases currently used in schools. The output of information depends on the use of logical connectors, which are not readily understood in the context of the data humanities topics produce. Getting children to see their own hypotheses in terms of logic is a major task. In this case it proves helpful to go straight for graphical output, bargraphs of key data, even very simple correlations. From this output children can progress to questioning the records following the schemes provided by the database. In choosing a database teachers should look very carefully at this area (usually a combination of the search and print commands) and see how readily they think the children can understand and handle it.

Can data handling help?

Can data handling help the development of concepts? If concepts are really the "black holes" of humanities teaching, to which we are constantly guiding children hoping that one day they will form the concepts we decide are important, then anything we can do to fill these black holes should be welcomed. The trouble is, if data handling is a method in the way I have tried to describe it then should all the children's experiences which are in any way capable of being processed into information be seen this way? Would such an approach help us to sort out a proper emphasis on creative activities like art, craft, music, drama and poetry, with data processing helping in all the areas which are concerned with information skills? Ready made data bases offer attractive possibilities, though only within a structure which emphasises the children's work with their own data collected and processed themselves.

Data handling is seen by many teachers as one of many ways of acquainting children with IT and therefore preparing them for life and (hopefully) work in the last part of the century. But there is, or could be, more to it than that. It would be a revolution if the formation of concepts in the humanities began in part to emerge from children handling information for themselves, as it were creating it from data they decide upon and collect. Users of information in this way learn to process, manipulate, understand and apply it and so move into the position of people who understand structures and therefore concepts. Consider the distinction between and the connections between systems analysis and programming in the computer world. The one depends on the other. Can we devise ways of learning in the humanities which allow children to practice both skills and from this develop real understanding not only of the concepts of the subject area they are studying but of knowledge itself?

1 Taba, H et al A Teachers Handbook to Elementary Social Studies, Reading, Mass 1971
2 Bruner, J Man a course of study Centre for Applied Research, Univ of East Anglia 1968
3 Blyth, A et al Place Time and Society, 8-13 Curriculum Planning in History, Geography and Social Science Collins 1976
4 Sir James Lighthill Report on AI to the Social Science Research Council 1973
5 Papert, S Mindstorms, Children Computers and Powerful Ideas Harvester 1980



Learning through Control – or "The Story of Control before the Micro" By Jim Flood

Department of Creative Design
University of Loughborough

I suggest that you and your children embark on a slave hunt. Didn't you realise that we live in a slave society? How about finding out how many slaves we have working for us, where they are kept and what different kinds we use?

Let's start with energy slaves. We each have the equivalent of seventy-five hard working healthy slaves at our command. If we add up all of the energy we use in this country for heating, lighting, industrial processes and transport, and then divide this by our population, we find that each of us uses 5 kilowatts at a continuous rate both day and night. If you are not sure what a kilowatt is, think of a small electric fire; this will probably be rated at one thousand watts (one kilowatt). So each of us is using the energy required to run five small electric fires. A fit and healthy person can, working hard, produce continuously one-fifth of a kilowatt of energy. So we each require the equivalent of twenty-five slaves to provide us with sufficient energy – and since we could not reasonably work them for more than eight hours, we would need three shifts. Hence we each have seventy-five slaves working for us – in America each person has one hundred and fifty!

We get energy of course from oil, coal, gas and nuclear fission, not from hard working slaves – but it is useful to be able to think about the amount of energy we use, and just as important, the way in which we control this energy using mechanical slaves.

Let's start our slave hunt in the home. What sort of energy is used for heating, lighting and cooking? What sort of mechanical slaves control this energy? Some of these slaves we have to command by pushing or turning (have you thought of any yet?). And some slaves work automatically for us; for example, turning the oven down when the right temperature is reached; switching our heating on and off at different times of the day and keeping our rooms at the temperature we require. Some of us even have mechanical slaves which do our washing for us – they fill the wash tub, heat the water, wash, rinse and spin dry our clothes. How is your slave hunt going so far?.....Have you thought of the mechanical slave which fills the 'loo' cistern to the right level after it has been flushed? This slave has been in (or just outside!) our homes for many years. There is also the slave which switches the light on each time we open the fridge door and another which keeps the fridge at the right temperature.

I'm sure that if you were to prepare your class for a nature walk in the local natural environment, then you would teach them to classify some of the plants, insects and animals they would 'discover'. You might also teach your pupils to look, identify and then 'see' their 'discoveries' with a greater depth of meaning and understanding. You might also be concerned to introduce your pupils to the correct terminology in order to expand their vocabulary.

Perhaps we should apply this scheme to our slave hunt in the local technological environment. Although I'm taken with the idea of energy slaves and mechanical slaves as a means of introducing the concepts, we perhaps need to work towards the terms *'energy systems'* and *'control systems'*. For example, a switch is a control system which is part of the energy system we have in our homes. We can classify energy systems in terms of coal, gas, oil and electricity, and our control systems in terms of:

manual – that is requiring an input (push, pull, turn) from a human; or–

automatic – that when turned on it works automatically until it is switched off or the task is completed.

We can further classify control systems as *electronic* (no moving parts), *electro-mechanical* (some moving parts) and purely *mechanical* – like our 'loo' cistern. Your more enthusiastic pupils might also wish to find out about further systems of classification such as *open loop, closed loop, positive feedback* and *negative feedback*.

What about some historical aspects to our slave hunt? Our technological environment can be seen as the development of control over our natural environment. Have you considered the lever as a control device – it enabled our ancestors to increase the force they could exert with their muscles. What sort of energy system and control system did Hero use to open and close the doors of the temple in Alexandria? Leonardo da Vinci developed some wonderful control systems, including one which automatically rotated a cooking spit using the hot air rising from the fire. The first mechanical clocks used energy stored in a falling weight (converting potential energy to kinetic energy), and later energy stored in a spring (strain energy) with a device called an escapmant mechanism which controls the flow of energy at a uniform rate and so drives the hands of the clock at the right speed. Can you hunt down an escapment mechanism?

We can continue our slave hunt on a 'technology walk' through our local environment. It will not be long before we 'discover' traffic lights, a level crossing barrier and automatic doors at a supermarket. What sort of energy system and control system do these use? It will also not be long before we 'discover' that the microprocessor is now at the heart of our latest control systems – which leads me to my final two points:

1. You can make children more aware of their technological environment through a study of energy and control systems – and hopefully, such a study will help them to understand it and improve their capability to determine the level and style of technology they will wish to live with.
2. If you are going to use your microcomputer as a programmable microprocessor to control a set of traffic lights or a buggy, doesn't it make sense to set the concept of control in the wider, and more important context?

Good hunting!

Postcript

Energy is measured in a unit called a Kilowatt hour (that is one kilowatt used for one hour) or Joules – a Joule being one Watt used for one second. How many Joules are there in one Kilowatt hour? How many kilowatt hours of energy is each person using over 24 hours?

Sample annual energy budget for a family of four

Electricity .... 10,000 kwh of energy
Gas .... 45,000 kwh of energy
Coal .... 4,300 kwh of energy
Petrol .... 37,000 kwh of energy
Food .... 4,800 kwh of energy

1 ton of coal = 8,000 kwh. 1 gallon petrol = 47 kwh.

Microcomputer control of 'traffic lights' can be achieved on screen without the need for an interface unit. One of my students has written such a programme with a supporting booklet. For further details write to Phil Songhurst, Department of Design and Technology, University of Technology, Loughborough, Leics, LE11, 3TU.

Biographical details

Jim Flood is a Lecturer in the Department of Design and Technology at the University of Technology, Loughborough. Adviser to ITV Schools series "Starting Science", Adviser to Department of Education and Science film "Technology Starts Here" Part-time Open University Tutor in Technology Author of "Starting Science": Book 1, Working Models" published by Heinemann

Computer Control by Tony Bishop

Headteacher, Aveton Gifford Primary School

This article first appeared in Primary Swift No4, 1984, S.W. MEP, and is reproduced with permission

The scene is a familiar one throughout the county. A small village primary school, two teachers and 40 children in a mid C19th building.

A hot summer afternoon, the junior class working in groups or individually, everyone beginning to wonder when Sir will announce its time for the swimming lesson.

However, for one group concentration is absolute. They are the self-styled 'Avengers'. Three older children who are at the computer. None of the group is watching the screen, all attention is directed towards a large map spread on the floor over which a smart black and red truck moves steadily and precisely. The truck stops, swivels on its axis then moves off at an angle into a simple model of a factory represented by an open sided box.

'Look we got him right in the gate'

'That means the first run needs increasing to a bit more than 2½ seconds, let's try 2.7'

'Get that down Marc or we might forget what it was'

'We shall need to turn in the factory to get out again. How about 135°. That's a 90 and a half. Should be about 1.4 sec. because it's quite a 'grippy' surface'.

'Let's get that in and try it.'

Attention switches to the keyboard and 2 or 3 lines are added to a simple program. Another line is edited and the screen display tidied up and critically checked through.

'Should be O.K., let's try it'

The truck is replaced in an exact starting position and on the command RUN the computer sets off on its journey across the imaginary surface of 'Crystal'.

The journey is considered successful and the program saved on disc along with similar efforts by 3 other groups all equally intent on visiting the six locations shown on the map.

Users of the adventure program 'Flowers of Crystal' might recognise parts of the children's conversation.

The older groups, mainly 3rd/4th year juniors had been using the program for some time and had become very involved in finding the elusive 'flowers'.

Folders of maps, painting, stories and poems were being enthusiastically produced by each group. One boy who was very keen on studying space had made a chart of the various surface conditions likely to be found on the planets. Various plans were produced about how each group thought it might travel on 'Crystal'.

It was at this point I introduced the children to the idea of using the computer to control a model through a buffer box using a Lego Buggy.

The class had some experience of working on science-technology projects, some of which involved making vehicles of various types. Some were powered by small electric motors and batteries. Older children had produced methods of controlling their models with hand held switches or other semi-remote control ideas.

By using a buffer box, which I obtained from Dartington ITeC, linked to the computer I saw a way of extending the work in science and at the same time introducing the children to challenging concepts involving simple robotics.

The Lego Buggy is simply two Lego motors linked side-by-side, with each motor driving just two of it's normal four wheels. If both motors are 'on' the Buggy goes straight ahead. If only one motor is 'on' the Buggy turns either left or right. The angle of turn can be accurately controlled by the time sent from the computer. Hence the very knowledgeable discussion between the 'Avengers'. The children became very experienced at estimating angles and time. I should also add that the pupils working with the Buggy all had considerable experience using the 'Dart' program (a turtle graphics program for the BBC microcomputer).

The Buffer Box is an external control panel, linked to the computer, from which a large number of functions may be operated.

A short program is typed into the computer which puts it in command of the Buffer Box.

This is saved on a disc which we reserved solely for Buffer Box activities. Each individual Buggy program could then be added to the existing program and stored for later use:

An example could be:

Line 10 PROCOUT (3) powers two motors i.e. 1 + 2. Buggy goes straight.

20 PROCWAIT (6) for 6 seconds.
30 PROCOUT (1) powers one motor
40 PROCWAIT (2) for 2 seconds. Buggy turns 90°
50 PROCOUT (3) two motors Buggy goes straight
60 PROCWAIT (4) for 4 seconds
70 PROCOUT (0) both motors off
80 PROCWAIT (2) for 2 seconds.
90 GOTO 10 repeat sequence.

The program can be changed easily or added to and each group or individual can design and store their own program.

The Lego Buggy, which we linked to the Buffer Box by a long four strand wire, can be adapted or added to. One group thought that a three wheel version would be better for turning but after extensive testing returned to the original version.

Allowance has to be given for various types of running surface, a smooth, non slippery base proved most suitable. A great deal of observation, recording, evaluating and adaption took place.

The older children had followed the BBC Microelectronics course last year. The present 4th year children might well be capable of applying some of the circuits included in the course either to the Buggy or to other models and functions operated by the Buffer Box.

At present a group is working on a set of traffic lights which we hope to operate with the computer and we have plans to make a model house rather on the lines of a simple doll's house and use the computer to control the various functions i.e. lights, heating, cooker, doors.

Meccano and Fischer-Technik models will be able to be operated via the Buffer box although the motors we have at present tend to be rather inaccurate. Eventually as funds allow we intend to obtain some stepper motors which will allow much more precise control.

The range of educational use in Maths, Science and Language is clear. However most importantly these activities develop the strategies of planning, thinking and logical organization, supporting the ability to plan ahead – to use the computer as a tool, to make adaptions and to extend their present knowledge.

These are the skills I see beginning to develop in my pupils when they use the computer in the way described.

Can Control Technology be Taught in Junior Schools?

by Reg Eyre,

College of St. Paul and St. Mary, Cheltenham

My aim was to try to find out what was possible with normal classes of children using limited facilities and resources but a fertile imagination.

I have identified the main aspects of this type of work as follows:

Problem-solving
Investigations
Decision making
Manipulation of materials
Understanding of control
Understanding of systems
Use of computers
Use of computer language
Group work

The order in which these topics could arise was not known by me, or others I have spoken to. The possibilities are also unknown. Many lecturers extol the educational benefits of letting children experience control technology using computers, but have apparently NOT tried these ideas in actual classrooms. The nearest we have come to genuine classroom practice is the use of this work, for research purposes, with small sub-groups of children and with generous equipment provision.

Possible Objectives for this work

1. That pupils should acquire interest and enjoyment in problem-solving, investigation, experimental work in groups.
2. That pupils should acquire knowledge of some facts and concepts and some practical skills.
3. That pupils should acquire an acceptance of the value of co-operating with others in experimental investigations.
4. That pupils should accept the value of co-operating

with others in practical and experimental investigations.

5. That pupils should acquire an ability to describe information, observations and conclusions in their own words.

6. That pupils should acquire some technical vocabulary and be able to communicate using this vocabulary.

7. That pupils should be allowed to develop an ability to think and act creatively within some limitations.

8. That pupils should acquire an understanding of the hazards associated with experimental work.

9. That pupils acquire an understanding of some basic ideas so that they can be used in familiar situations.

My first attempt at this work came about after a meeting with a local teacher, Angela Michell, who works at Dunalley Street Junior School, and was confronted with the prospect of 34-J3 and J4 children to teach "Computer Studies". I have used this situation to give me the opportunity to try some of the above ideas.

Angela claims to have no aptitude or ability when it comes to practical technology and my aim was to give her confidence in leading children in this area.

My own background is that I can use modem technology, it does not worry or frighten me. My attitude is an essentially practical one, in that if something goes wrong, I am happy to attempt to repair the fault using any method that seems appropriate at the time.

The approach I aimed to take with the children was
(i) to make them work in groups of between 5 and 7,
(ii) to encourage discussion of ideas,
(iii) to encourage co-operation within the groups, and
(iv) to encourage the recording of self progress within each group.

The general outline for these sessions was to be:
(a) Introduction – what is technology?
– what is meant by control systems?
– where is this technology?
– Simple problem solving exercise
– paper water butt
(b) Building phase – solving problems as set in
– making buggies etc.
(c) Understanding electricity and switches
– Making buggies switch off
– Use of batteries
(d) Using computers to control other things

Summary of work

1st Session – Introduction – discussion of group work – aim set of solving problems – making buggies – making connections to the computer – discussions on switches, control

I talked about plugs and switches as a prelude to talking about "CONTROL" which I wrote on the blackboard.

I then used the Turtle to demonstrate another aspect of control. I arranged for the Turtle to get a wheel stuck so that I could introduce the idea of artificial intelligence and automation with open and closed systems.

I explained that I wanted one person within each group to do the writing for the group and gave out a sheet of paper to each group and asked them to write down examples of everyday objects that are automatically controlled.

We then discussed the traffic light sequence and I asked them to discuss in small groups other "things" which controlled traffic. Some groups were able to not only consider people, but also signs and fixtures such as roundabouts.

The final assignment I wanted to leave with them was, to build a structure from a single sheet of paper, that would hold a weight as high as possible. I explained that I would mark them on a combination of weight and height.

I also explained that as a long term assignment I wanted them to build a "buggy" using cans, battery and electric motor.

The session ended with some children taking some paper for practising towers, others came to look at the cans and motor I had brought.

I think the first session was an "ice-breaker" from the point of view of working in small groups, writing things down as a group, having to think of possible answers rather than just copying things down.

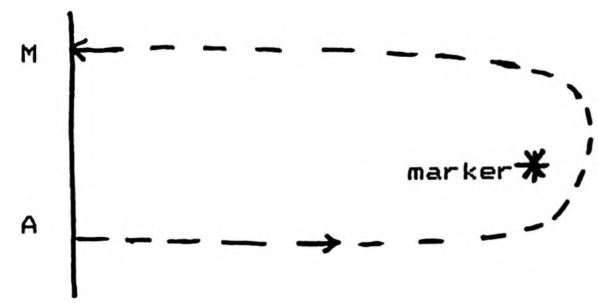
2nd Session – making a paper tower – paper "holder" to carry water.

I explained about the use of exercise books to the class and how I would like them to write up their thoughts. This aspect will be worth studying, to see if children can co-operate with each other, and as a group, to record their results. A major problem is the difficulty of expression and speed of writing.

The first assignment was tackled well. Most of the groups came up with good ideas. No help had been given to the children.

I noted the lack of recording of what they were doing so I stopped their experimenting several times to impress on them the importance of recording initial thoughts, as well as the results of what they had done.

For the second problem, we removed all the sheets of paper and asked the children to write down what they intended to do. Only after I had noticed that all groups had recorded something, however, minimal, did I give each group a single sheet of paper and explained the testing and measuring procedure.



The receptacles made were filled with water at A, walked around a marker and measured for capacity at M.

Despite a lot of purposive, excited noise, this operation went well. We then walked back into the classroom to allow the children to record their results.

The after-lesson discussion revealed the disbelief that children of this ability could solve problems of this nature – and the speed of solution.

3rd Session – writing ideas for making a garden roller – discussing the making of a buggy using cans.

I wrote down headings on the board:- *Problem, Materials, Drawing* – and asked them to do the same in their group books. I then asked them to write out their materials requirements at the same time as they looked at their design.

All groups came up with interesting possible designs and were beginning to write down more information than the previous two sessions. While they were doing this, I added another title:-

Further Problems, and explained that I wanted them to note down points such as how they were going to join different components, make holes in the oil drum, etc. This latter activity seems to need more encouragement since the children get over involved in the design stage and appeared to ignore the recording of any developed problems.

I then brought the class's attention back to the designing and making of the buggy using beer cans and wire. I gave them the same headings and asked them to design the buggy and produce a materials list.

To overcome frustrations of one book with three or more possible designers, we gave out extra sheets of paper so that all members of the group could draw simultaneously. At least three groups were making detailed measurements which I thought was highly commendable.

4th Session - two practical activities
(i) making the buggy
(ii) showing that the electric motor is working.

Angela and I put out the materials; cans, (in the bases of which we had put holes), wire, sellotape, card, batteries and motors.

Once the activity started, there were lots of discussions and interest, especially concerning the motors, to the extent of less interest in the buggy problem. All groups managed to connect batteries to motors using the wires provided, and on questioning were able to talk about completing circuits of electricity.

Allan Philpot observed the session and feels that my attempt to get the children to record their work in writing may inhibit their progress, perhaps making it too much like normal school work.

I feel that the written recording process is important, as being an aspect of communicating ideas.

5th session – putting the motors on to the buggies.

I gave out the buggies and asked them to attach the motors. There followed lots of activity, while the children experimented and played with various elastic bands, generally causing undue strain on the buggies by trying to force the bands around both cans.

The main idea seemed to be to rest the motor onto the top run of the elastic band and thus achieve drive.

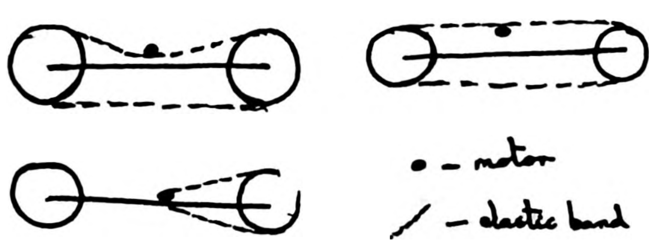
One of the groups of girls decided to restart making their buggy, while another group had not realised that the motor had to be fixed otherwise it just rolled off the buggy.

Only two groups, of boys, managed to get the motors to drive the buggy – most groups managed to get some drive some of the time, and one group of girls had so many problems with their buggies that they had not got as far as experimenting with drive.

6th Session – discussion of problems arising – i.e. strength of materials, chassis, triangulation, motor drives – open practical work.

I had decided to start with a formal session. I think that I am not sure that the children are able to restart their buggies without some guidance or coercion. The buggies built so far appeared to work but were structurally weak and, when working, appeared to do so almost by accident. I would like their solutions to be more consistent so that they may derive more satisfaction from them.

I asked them to consider alternative drives from the motor to the roller and got these results:



To my pleasant surprise, several groups dismantled their buggies and were experimenting with different layouts. Some stuck to the original layout while others were trying triangles, etc. Unfortunately we hit the end of time just as the activity was becoming most productive.

7th Session – practical session – race.

Angela and myself were mainly involved in cutting wood, drilling holes and slicing wire – i.e. all the activities we considered potentially dangerous if inadequate supervision was available.

EVERY group had some measure of success i.e. a buggy that ran for a small distance. At the end of the session, Angela organised a race in which three of the groups experienced mechanical failures, all other buggies worked efficiently.

8th Session – practical session – making a switch – idea of computer control.

I asked them to construct a switch that would turn the motor off when the buggy hit an obstacle.

Most buggies ended up being substantially stronger than the previous week's.

The switches varied from "tumbler-type" i.e. the connection lay loosely on the buggy until the wall was hit when the connection broke as it fell off the buggy, to "proper" switches.

Towards the end of the lesson, I showed the class the I/O buffer switch and connected it to the computer and went through the sequence of turning the LEDs on and off, i.e. ?65120=1 or ?65120=2 etc.

When someone suggested that this was like traffic lights I agreed and asked how it might be possible to make them operate in a similar way.

I then took a buggy, from a group of J3 girls, and connected the computer switch in place of their switch and ran the following program through it

```
10 ?65122=15
20 ?65120=0
30 FOR T=1 TO 2000
40 NEXT T
50 ?65120=1
60 FOR T=1 TO 5000
70 NEXT T
80 GOTO 20
```

The program was written on the board and discussed with the children.

I got the children to count rythmically how long the motor was on and for how long it was off.

9th Session – videoing results – connecting buggies to the computer.

The plan was to divide the class into three working areas.

Area 1 – in a separate room, making their own video (unaided).

Area 2 – main classroom tidying up buggies, final video practice.

Area 3 – in classroom, connecting buggies to computer.

Once the activities started, I was heavily involved supervising the groups using the computer. I was pleased to see that the children were able to sequence the traffic lights for themselves, that they understood the program in BASIC and were able to modify the time loops easily, that they were confident in connecting all the bits to the computer, as well as wiring all this to their buggies.

Angela's Account

During the summer term 1984 Mr Reg Eyre came to Dunalley Street School, Cheltenham, and began a Buggy Building project.

The project was with a group of thirty-five third/fourth year juniors. The children had been given a choice at the start of the school year between continuing to learn and play the recorder or to do something with the computer. I was asked to teach those who opted for "computers". I found the task frustrating and difficult as there was only one BBC Micro-computer to be shared among thirty-five children, and the lesson was only about fifty minutes long.

As one might expect, the children had great enthusiasm for the computer and looked forward to their lesson. I found, however, that I was merely occupying their time rather than using their enthusiasm for anything positive. I explained this situation to Reg and asked him for ideas. He came back to me with the idea of Buggy Building and an offer to come to the school every Friday to lead the project.

The basic idea of the project was that the children, divided into small groups, would work towards building a buggy from scrap materials. The next stage would be to connect the buggies to the computer in order to control their movement.

As I considered Reg's ideas I became interested and worried. My worries stemmed from the fact that I knew nothing about building buggies, connecting up wires and linking things to computers. My worries were not only for myself. The more I thought about it, the more certain I became, that the children would never be able to do it. I wondered if Reg was expecting too much of us all.

Reg's pattern for most sessions involved giving the children challenges – small problems that they had to solve. One of the first problems to solve was how to use one sheet of paper to support as heavy a weight as possible. I was convinced that the children would have no ideas at all – but they proved me wrong. All groups thought of an idea, and some groups went on to think of several solutions. For several weeks the children were given problems to solve like using one sheet of paper to carry as much water as possible or designing a garden roller from materials found in an average garden shed. The lessons were noisy but as time went by I saw the groups beginning to work together. The members of each group began to listen to each other and were competently discussing their ideas. The children were encouraged to work on the problems themselves. Reg and I did not go round the groups answering questions or explaining how to do things – that was left for the children to sort out for themselves. One session involved the giving out of batteries, motors and leads. Reg explained that it was possible to connect things up and make the motor work, but he left the children to find out exactly how to do this. It took them hardly any time to sort out that problem even though they had not had school experience of working with electricity/circuits before.

From strength to strength

The project went on from strength to strength and all of the groups built a working buggy. They raced their buggies and were very proud of their achievement. Some groups even devised rather effective switches for their buggies. Reg showed individual groups how to connect the buggies to the computer and then to control the movement of the buggy from the computer keyboard.

The project was enjoyable and highly successful. It created a lot of interest throughout the school and among parents. Throughout the project I was continually surprised at how well the children solved all the tasks put before them. Each week I saw them tackling difficulties that I did not expect them to be able to cope with. I now see that I totally underestimated their ability, which is something the project taught me. They all experienced success throughout their work and were thrilled to demonstrate their buggies to anyone and everyone. They looked forward to the lesson and would check to see if Reg was coming in to school. Many children thought about the problems of their buggies at home and would discuss them back at school. Even children that were not involved were interested and curious about what was going on and many wanted to join the group.

Was it too hard?

When I asked the children if they had enjoyed the project they all agreed the answer was "yes". I asked them if it was hard. Most children said that there had been hard times but that they had sorted things out. One boy said, "It was really hard at times, but those were the good bits really."

Although I was quite wary at the start of the project, I found it so worthwhile that I would like to try other "buggy building" types of projects. It was not just the final result of the project, the buggies, that impressed me. I was also impressed with several valuable gains that the children made on their way to building their buggies. I was pleased to see them gaining practical experience of handling a variety of tools and materials. They acquired some knowledge of structure and stability by trying different ways of building the buggies. They also found out for themselves how to make electrical circuits and switches. The children gained from working in small groups and developed quite a co-operative spirit within the group. Their communication skills were constantly being used in a real situation where group members would discuss and reason through different ideas and strategies. This really culminated in the making of a video film, where the children did the camera work, demonstrations of their buggies and explanations of how they had built it. They experienced a great sense of achievement throughout the work and I feel that both the class and myself have benefited from the experience.

Summary of Ideas by Reg Eyre

Were my aims realised in these sessions?

Do I consider that such aims reflect my philosophy of learning?

Were such aims achieved?

Could other teachers and children do similar work?

Were any aims not achieved? If not, could they be?

My main aim in doing this work was to see how far an ordinary class teacher could go in getting children to use the idea of "control technology".

The limitations were to be the equipment provision and limited knowledge, so that some idea of the problems facing ordinary class teachers could be understood and a programme of help provided for those who wish to do similar work.

My personal philosophy of classroom activity is that it should be mainly about learning NOT teaching. The child should be taking a full and active part in its own learning processes and to this end these activities should include problem-solving, investigative work, group work, discussions with peers, as well as teachers. I accept that formal teaching (exposition) has its place but it should not be the major activity in the classroom. The major use of the exposition technique is, in my opinion, to enforce a type of discipline, initiate or conclude work or explain, in a shorter period of time, something which would have to be repeated too many times to different groups.

Did the work at Dunalley Street School reflect this type of approach?

I think it did, from the point of view that I was aware of trying not to give solutions to problems or even give a direction in which a possible solution may be sought. The use of the class teacher and student observers was to keep me aware of this approach and I wanted them to observe it, when and how I deviated from this stance.

The occasions when I spoke to the class altogether, were used to explain organisational procedures, i.e. where the materials were, use of a recording book etc. I always tried to encourage the children to give me alternatives, i.e. a kind of open aloud thinking process. For example, when talking about strength of materials, I would let the children write down their ideas in their groups then tell me to write down on the board the various methods or ideas used for strengthening. In general, I tried to take each idea, in turn, and discuss it openly, even if it were not my idea and no matter how outlandish it may have initially appeared. Were all the content aims achieved?

I had got the class to the position of having made their own vehicles and putting motors on, some had managed to put on some type of switch, but only a very few had any real concept of what the switch was doing, i.e. the control of the buggy. To have perservered with the computer program form of control would appear to me to go against my view of the children's knowledge at that time. I felt it important that they should experience and understand the simple notion of switching. The means by which I chose to do this, i.e. actually making a switch, may have been wrong, I could have given them a switch, but the approach adopted was consistent with the style and manner in which I wanted to operate with this class. It could also be argued that if I had given them a ready made switch, I could also have given them a ready made buggy. I did not give them a buggy nor did I give them easy materials such as meccano but junk – I felt that this would sharpen their problem solving skills.

The only unavoidable part of this series of lessons that could be called formal teaching was the showing of the computer program, and the explanation of the connections and parts of programming. This could be made easier if we had had a simple programming interface language with commands such as:

MOTOR ON
PRINT "MESSAGE"
WAIT 30
MOTOR OFF

This could have been written for this project but I would prefer to wait until a LOGO-type control language is available – I believe this is being developed by AUCBE in Hertfordshire. The connections to the computer may also have been simplified and I did toy with the idea of combining the buffer board and switch into one unit. This would have saved some of the explanations about protecting the computer's internal circuits. On the other hand, I would not like the children to think that one could connect anything directly into a computer without some form of interfacing circuitry.

Could other teachers do this type of work?

The teacher, whose class I used for this work, is already thinking in terms of either replicating this work, or slightly modifying it for use next year. Two other teachers in the school are also thinking of undertaking similar work having only seen the results of each week's work.

I believe that any teacher could do exactly the same kind of project in making things from junk, putting motive power on them, possibly controlling them with, or without, a computer. The role of the computer can be played down and relegated to a fairly minor part of the total scheme of work. The amount of BASIC required can be minimised i.e. control codes and FOR loops are necessary and the confidence of plugging in an Input/Output buffer board to the user port if required.

The worksheet I used seemed adequate enough but perhaps needs using by a less confident teacher when I am not present.

The justification for such a project is that it overlaps the subject areas of design, technology, science, art, communication etc. and invokes and develops the use of skills in problem-solving, discussion, investigation, manipulation of materials, creativity, etc.

I would hope that teachers would NOT use the "Blue Peter" approach of handing out ready made designs and the unthinking following of sequenced instructions. This is too easy to do and does not put the control of the activity into the hands of the children. What it does, is to increase the authoritative power of the teacher by making the children aware that the teacher must know all the answers and is the repository of further knowledge. What I am trying to do is encourage a mutual learning approach where there exists only better solutions to problems and where no answer is correct. This, I feel, would remove the moral judgements that are made on children's work, which is seen especially in mathematics where heavy emphasis is placed on the correct answer, and not enough emphasis on why an answer may be reasonable or not.

Bypassing the keyboard to meet special needs by Phil Gamble

Fountaindale School, Notts.

First of all I must state that at the time of writing this I am not teaching in a 'normal' school! ('Who is?' I hear you ask). I am a teacher in a school for physically handicapped children. This obviously makes the use of computers somewhat different.

We have had computers at Fountaindale for nearly four years, and the way they have been used, and probably the way they still are used, will not be familiar to you. It is not my intention in writing this short piece to labour the problems of the handicapped user, but rather to inform you about some of the interfaces we have HAD to use to enable our children to access the computer. These may be useful to you with young infants, or older junior children who have learning difficulties.

The need for a simpler system

Switches

Many of our children cannot use a computer keyboard as it stands because they lack fine motor control. This means that a simpler system is required. At the very simplest level this consists of a single switch. By using this switch and custom-made software, the child is able to make use of the computer. The programs we use tend to be cause and effect – if the child presses the switch, it causes a picture to appear on the monitor. This type of program can be extended by software to become quite a challenge to our children. The switch can be used with different software to give the child a chance to answer multiple choice type questions of many kinds. The question appears along with 2, 3, 4 or 5 answers. Each answer lights up in turn and when the child thinks the correct answer is lit up, he presses his switch. This could have certain advantages for normal children in that the child is not worried about the vast keyboard, his spelling is not being watched, and thus the correct answer wrongly spelt is not marked wrong. The slower child can keep up with his more speedy peers, and so on.

Moving onto 2 switches gives even more possibilities, providing that suitable software can be obtained. (The provision of suitable software is a subject worthy of a book rather than an article.)

Single switches and/or 2 switches are reasonably easy to obtain. They can be cobbled together by an enthusiastic amateur, but this does not solve all the problems, and I am sure that it is not a subject that has made you leap out of your comfortable armchair at this time of night, full of enthusiasm. (I am assuming that you are reading this at roughly the same time as it was written – in the early hours!). Therefore, in an attempt to make you read on, I will mention some commercially (sorry about that word) available devices that have proved to be very useful to us.

A touch sensitive keypad

There is a 9 touch sensitive keypad on the market (see suppliers at the end) which comes with software to enable children to deal with money in a more realistic way than the normal keyboard. It has an overlay of the coins up to 50p. The children are required to use the keypad to make given amounts with the smallest number of coins and to give change for given amounts and so on. This has proved to be beneficial, irrespective of disability, but what has made it more useful is that the keypad can be "user defined". This means that, given access to a 'tame' programmer, other programs can be devised which cater for your children in a way which most educational software does not do.

The concept keyboard

A further extension to switches which may be more useful to you is the Star Microterminals Concept Keyboard. This combines the simplicity of switches with the useability of the keypad. It consists of a flat touch sensitive pad which can be 'programmed' to be one switch or 128 switches to do whatever you want. This keyboard has not got a large amount of software available for it at the moment (or at least I am not aware of it), but some of the programs that do utilise its potential are programs testing bigger and smaller, shorter, taller, wide and narrow, and other mathematical concepts. Programs linked to early reading can quite easily be tailored to the reading schemes in use in your school. There are shape and colour recognition programs for very young children. There is also a very good program called Touch Explorer which enables the teacher to very simply program the keys to 'say' anything at all. In this way the child is able to explore the keyboard and discover for himself what is there. This excites me because it can be linked to almost any area of the curriculum and the teacher is completely in charge of the content.

Joysticks

The use of joysticks with younger children can also be exploited in the classroom. There are maze programs available, and to my knowledge, several drawing and painting packages come with a joystick option. As with all the interfaces I have mentioned, software is not available in vast quantities, but only by teachers using interfaces and complaining long and loud will this situation change.

Other products

There are several other products on the market which I feel show that the ability to effectively use a full keyboard will not in the future be as vital as it is at the present time. These are – the Bitstick, Bar code readers, The Mouse, Lightpens etc. They give me hope in my field of education – I hope they might give you pause for thought in yours.

Brief information about the above devices

9 Touch Keypad	ESM Ltd., Duke Street, Wisbech, Cambs. PE13 2AE
Concept Keyboard	Star Microterminals Ltd., 22 Hyde Street, Winchester.

Joysticks	Acorn and others
Touch Explorer	Bob Dyke, Manchester SEMERC
Bitstick	Acorn
Light Pen	Various sources
The Mouse	Apple Computers Ltd.
Bar Code Reader	M.E.P. see article in Acorn User December 1984

Using the "Prompt" wordprocessor by Roger Bates

Increasingly computer software for education includes programs that can be modified to provide for pupils' individual needs. MEP/CET Information Sheet 4 "Microelectronics and Children with Special Educational Needs" (available from the Manchester SEMERC, Manchester Polytechnic) lists software under three categories, Instructional, Discovery and Tool or Utility. The Discovery type of program allows for maximum flexibility in use, allowing pupils to use them at their own level and for teachers to integrate them into the work in the classroom.

The simple wordprocessor "Prompt" is listed as a Discovery type program. This enables the pupil to produce and edit a screen full of double height text which can then be printed or stored on disc or tape. Although the restriction to one page of text at a time (the display does not scroll) may be a drawback, it does allow the less able pupils to see the entire page as it will be printed and to perform any corrections on it in this form.

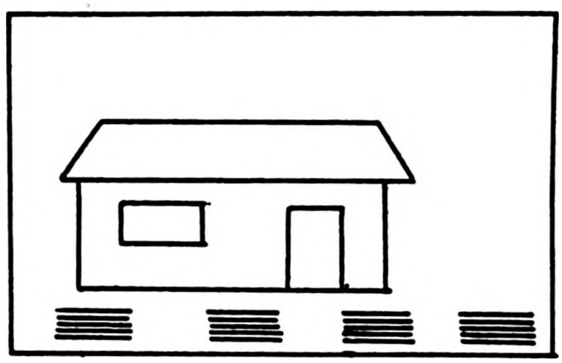
'Prompt' and a concept keyboard

This program will also use the Star Microterminal's concept keyboard as a means of input. There is a simple procedure within the program which allows the concept keyboard to be used as a whole word input device. With this an overlay can be prepared which will allow up to thirty-two words to be input to the computer. Thus the pupil can input text from either the concept keyboard or the computer's own keyboard. The preparation of these overlays is simple.

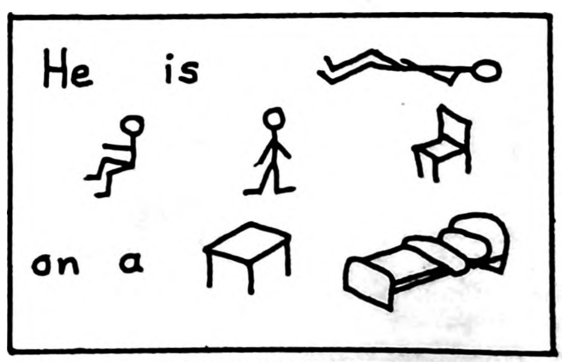
This feature has made this program one of the most useful I have found. It has enabled me to make good use of the concept keyboard for the first time. I have often felt that this device was of more potential than actual use.

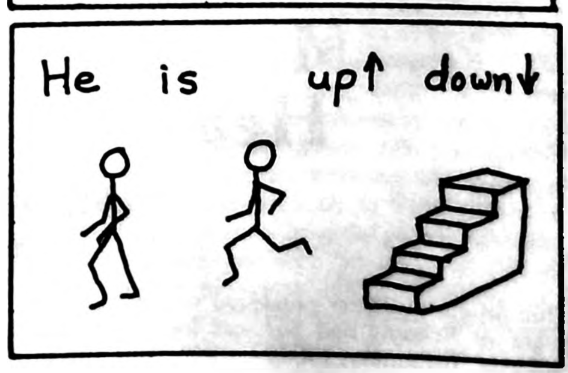
An overlay grid for the concept keyboard is provided with the program. It is divided into 4 columns with eight rectangles in each. Each rectangle is word-sized and when touched by the pupil will cause the word allocated to be input to the screen. I have found it best to use blank pages as overlays. Using a master grid drawn in heavy black and thin paper for the overlays the grid can be seen through the paper. While the overlay is prepared a covering of clear contact plastic will protect the sheet in use. The January 1984 Manchester SEMERC Newsletter has a useful article on the preparation of overlays.

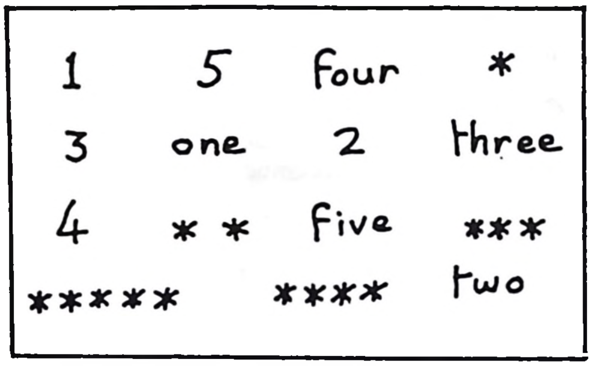
In their simplest form the overlays can be pictorial as in the House example shown, all the rectangles under the door produce the word door etc.. The picture is coloured and the shaded areas below give the colour name when touched. It is then possible to write "red roof" etc. Other pictures may not be so easy (try fitting a tree onto a rectangular grid!). A later version of this overlay may have the word written in as well. Phrases as well as words can be stored. On touching the roof could provide "This is the roof" on the screen. The preparation of different files for the same overlay can cater for a pupil's progress and allow its use with other pupils.



The Doing overlays give the word when the picture is touched, the sitting figure gives the word sitting when touched anywhere. Using the pictures and link words simple sentences can be written without using the computer keyboard. The drawings are coloured in a consistent way, in this case green for "things" and red for "doing". These are part of a series of overlays on a similar theme produced for an individual pupil who is profoundly deaf and will have to use a keyboard for writing. Once a theme like this is begun it is quite a quick process to produce the overlays when needed.







The number overlay gives the number name, the figure and a row of stars when the appropriate place is touched. The initial task is to match the number, its name and the appropriate stars together.

```
This is a sample of a printed
page using the PROMPT program.
The pupil can use the cursor
control keys to move about the screen
and fill in the spaces left by teacher.
 1. The house has a ... roof.
 2. The .... is blue.

The text can also have deliberate
mixtakes. Correcting these gives
practice in using the editing
facilities.
```

A prepared "Page" of text such as this can be completed by the pupil using the editing facilities of the program. It is a simple matter to prepare any type of text which can be completed by the pupil. This can be done from the computers own keyboard or from the concept keyboard with a prepared overlay.

Conclusion

The Prompt program can be used in many ways. As a simple word-processor it can provide an introduction to the use of this type of program. Pupils using it become familiar with a "real" use of computers, learning how their work can be stored and retrieved for further alteration.

The use of the "Concept Keyboard" as an addition or alternative to the computer keyboard and the flexibility of the program means that this package can be used for a wide range of pupils. With software like this good use can be made of expensive computer equipment, with the teacher and not the programmer in control.

From January 1985 an improved version of this program will be available on "Blue File" from SEMERC's. This means that it is free to copy.

Microtechnology and the Hearing Impaired Pupil by R G Dyke

Manchester SEMERC.

(This article was first presented to the Conference for Heads of Schools and Services for Hearing Impaired Children, September, 1984.)

There is no doubt that innovations in technology are bringing new opportunities for overcoming the problems encountered by the hearing impaired population. Some of these innovations are the by-products of developments in the fields of business and general communications. Some are due to the efforts of technologists and educationalists working directly for the benefit of the hearing impaired. Other opportunities are made possible by specialist teachers exercising their long established skills of making imaginative use of materials intended for mainstream pupils. This paper proposes to present examples of each of these processes.

The increasing use of microcomputers to communicate text via telephone lines in systems such as Telecom Gold means that deaf people communicating with text on the phone are no longer a small minority using highly specialised apparatus. They are using standard equipment which gives access to a rapidly increasing range of ordinary facilities and non-handicapped users. Even closer to the domestic hearth, Oracle and Ceefax on the television offer 'on-line' access to information services, and sub-titling for television broadcasts.

Devices to help

At the level of specialised materials, microtechnology can offer assistance to deaf students in several ways. Devices based on the oscilloscope offer visual feedback of speech patterns, while similar systems based on the microcomputer are able to do this in a particularly friendly and flexible way.

C-Speech is a specialised device needing no supportive computer equipment. Plugging into a black and white TV, it gives a visual indication of voiced sound, frication, and silence plotted on a variable time scale. Two traces are displayed for comparative purposes. A particular strength of C-Speech is the extensive and practical user manual, reflecting the research underlying the production of the device.

Visispeech, as its name implies, is a system capable of making voice pitch and energy (volume) visible to the user. Pitch is presented as a line graph, so that, for example, falling pitch over the duration of a sentence is clearly visible as a descending line across the grid on the computer screen. Voice energy is presented as a bar-chart so that features such as initial and final consonants form clear isolated peaks whose absence is obvious. Visispeech is based on a microcomputer so that changes to the display are easily made by the non-technical user, and print-outs of the screen are readily obtained for record purposes.

A very much cheaper device based on the BBC microcomputer, Micromike, presents the user with a variety of voice-controlled games. These may encourage vocal play, practise timing, volume, or duration of vocalisation, or demand combinations of these skills. The emphasis is on motivation and practice rather than precise analysis. In its present form, Micromike responds only to changes in vocal energy. The producers of the system are currently seeking support to develop the system to respond to pitch as well as volume, so as to provide games and activities practising control of vocal pitch as well as modulation and timing.

Specialised Programs

Specialised microcomputer programs may also help to correct the grammatical errors and omissions made by deaf children. As an example, the program "Square and Cross" from Hull University Department of Psychology invites the user to describe the relative positions of shapes on the screen, or to control the program by making demands to place the shapes in chosen positions. Grammatical errors are highlighted and corrected.

A different approach has been taken by the MEP funded 'Wordweb' project at Thorn Park School, Bradford. Wordweb is a completely new kind of active dictionary program mixing lively pictures and text in order to tempt pupils to explore linguistic relationships in a 'microworld' held in the computer's memory. In a sense, this is a computer adventure game, but it does not generate a fear of failure and the driving force is the pupils' curiosity and enjoyment. Like much other material developed recently for the microcomputer, Wordweb may be regarded as giving of its best in a small group situation.

In both mainstream and special education, programming effort is going into the production of software which encourages group activity to solve problems, to use information to reach decisions, to anticipate outcomes of particular choices of action, and to explore models of situations held in the memory of the computer. Much of this software is readily usable by the teacher of hearing impaired pupils.

'Touch Explorer' is a program which may be seen as illustrating several of these functions. The program was developed at SEMERC with the needs of slow learners in mind and is published as MEP Blue File material. This means it is freely copyable from SEMERCs, MEP Regional Information Centres, and many LEA school computer centres and resource staff. Touch Explorer allows the teacher without any knowledge of programming to store information on the microcomputer which is subsequently discovered by the pupil item by item as the sensitive key areas of a Star Microterminals overlay keyboard are touched. Information which is discovered is drawn or noted on the blank paper overlay, or models may be placed on the overlay. According to the needs of the pupils, the information may be presented in a straightforward way, or in a way which demands thought and discussion or even consultation of other resources. A completed overlay may then be used with the same program, which will serve to present an active commentary as features on the overlay are touched.

Another program using the Star keyboard, and hopefully to be Blue File shortly, is 'Prompt'. This was produced as a very simple and supportive word-processor. It was intended merely to provide a facility for the teacher to put the difficult and essential vocabulary of a topic on the keyboard overlay. The pupil would use the micro's typewriter keyboard in the normal way, but put in each of the harder words at one touch from the overlay keyboard. This has seen use in an unexpected direction with a hearing impaired child who is incidentally learning English as a second language. He is developing oral and written communication skills through composing sentences by touching mixtures of words and pictures colour coded on the overlay keyboard.

Word processing programs generally are of great value in freeing pupils from the fear of making mistakes. Standard word-processing packages, like 'Wordwise' on which this paper has been prepared (with showers of typing errors by the author), are easily usable by pupils in the classroom. For weak spellers, spellcheck programs are available which highlight words not recognised by the 'dictionary'. Highlighted words may either be corrected, or if correct added to the dictionary for future use. Specialised word processors such as 'Wordstopper' can be preset by the teacher to draw the pupil's attention to overused words such as 'very' or 'nice' and to offer alternatives. Some programs will take support to the extent of offering grammatically correct sequences of words for acceptance or rejection by the user, so that a grammatically correct (but not necessarily logical) narrative is sure to be produced. Daco's 'Story' program is an example.

George Derby produced his own overlay keyboard for use with language impaired young pupils during his headship of Hinderton School on the Wirral. Known as the Cheshire Keyboard, this now offers a large range of language development software. Programs with obvious applications to hearing impaired pupils include the 'Find the Sound' series, where the user is invited to touch, say, the pictures beginning with the sound 'th'. It may come as no surprise to learn that this material, developed for special needs pupils, has a very strong appeal to mainstream teachers of young children.

Manipulation of information is a useful vehicle for encouraging children to argue, discuss, and hypothesize, as well as to become vastly more familiar with the information itself. A whole family of computer software exists to prompt this process. The programs are known as databases. At least two of these programs are presented in a way which actively invite exploration by teachers and pupils completely new to microcomputers. The two examples chosen for presentation and discussion in this paper are 'Lists' and 'Tree of Knowledge'. 'Lists' is quite simply a jargon-free program which encourages the user to collect and examine information on any topic. Prompts such as "Please give me a word to look for" and frequent opportunities to check and correct input make the program immediately usable. It is available as an MEP Blue File program. 'Tree of Knowledge' is a commercial program which actively seeks information from the user on any chosen topic, incidentally forcing the user or group to refine its own understanding of the nature of the information which is fed in. Comments such as 'Give me a question to distinguish between a leopard and a tiger (a knife and a fork, a Fiat and a Volvo)' are a feature of Tree of Knowledge, as are the program's invitations to the user to guess what the computer has 'in mind' from snippets of information.

Many of the increasing number of teacher-modifiable and content-free programs intended for mainstream use will lend themselves to the teacher of special needs pupils through their flexibility. Examples of this kind of material are 'Terrible Tales' and 'Other Worlds'. Terrible Tales invites the user(s) to compose a story about a giant or a monster. An easily followed structure and a fair number of helpful prompts and comments are made by the program to lead the creative process along. Other Worlds invites the pupil to create an account of a fantasy world. Again, many prompts and a useful structure are given. The program not only comments on the information fed in, but goes as far as to run and report on simple calculations on the user's information, and even graphs the results. The outcome is a comfortable division of labour, with computer and user each doing what they do best.

The demands for support

The arrival of a new technology as a tool for teachers working in a particularly complex area of education may be expected to give rise to a variety of demands for practical support. When that technology proves unreliable from time to time and when it gives rise to rapid growth in availability of materials of highly variable quality and non-too-obvious application, the demands for support may be expected to become urgent and vociferous.

Mainstream schools are supported by the MEP's 14 Regional Information Centres and all the available material mentioned above can be viewed at those centres. The SEMERC's provide information, advice, and training for teachers of pupils with special educational needs. The four SEMERC's (Special Education Micro Electronic Resource Centres) are at Newcastle, Redbridge (London), Bristol, and Manchester. As local education authorities develop resources for local support, a national pattern of information exchange is emerging. The particular needs of people with communication problems are being met by the Communication Aids Centres at Newcastle, West Bromwich, Cardiff, Bristol, and London. A specialised Children's Communication Aids Centre has been established at Ormerod School, Oxford, with a northern representative based at Manchester SEMERC.

The information centres not only act as sources of advice, but, almost as important, guide development so as to avoid some of the worst excesses of duplication of effort.

The SEMERCs in particular are constantly looking out for ideas for appropriate software from teachers of special needs pupils – not from computer experts but from teachers with a real understanding of pupils' needs.

Sources of Material and Equipment

C-Speech. SCI Instruments, Spirella Building, Bridge Road, Letchworth, Herts, SG6 5ET.
Visispeech. Jessop Acoustics, Unit 5, 7 Long Street, London E2.
Micromike, Magpie Systems, 51 Guernsey Close, Widnes, Cheshire.
Square & Cross. Dr A Rostron, Dept of Psychology, University of Hull.
Wordweb. For publication early 1985. Developed at Thorn Park School, Bradford.
Touch Explorer, Lists, Prompt. (MEP Blue File). Freely copyable from RICs, SEMERCs, LEA resource centres.
Concept Keyboard. Star Microterminals, 22 Hyde St, Winchester, Hants.
Wordwise. Computer Concepts, 16 Wayside, Chipperfield, Herts.
Wordstopper. From Language Development Pack, LTS Ltd, Haydon House, Alcester Road, Studley, Warwickshire.
Story. DACO, 59 Mackenzie Road, Birmingham, B11 4EP.ra
Cheshire Keyboard. George Derby, Assessment and Special Education Centre, Holt Road, Wrexham, Clwyd.
Tree of Knowledge. Acornsoft. Available from ESM, Duke St, Wisbech, Cambs. PE13 2AE.
Terrible Tales, Other Worlds. Longman Micro Software, 33-35 Tanner Row, York, YO1 1JP.

New Tools for Reading and Writing by Sally Millar

Research Speech, Therapist, CALL centre, University of Edinburgh.

1. BACKGROUND "... but is it really EDUCATION?

In a Special School for Cerebral Palsied children, in the early days of microcomputer use, the emphasis had firmly been on "Therapy" or "Rehabilitation". The majority of these physically-handicapped children were Non-Speech, and many used Blissymbolics or Sign Language to communicate. Apple 11+ computers were installed, primarily to run programs for the development of these non-speech systems, (BLISSAPPLE and BLISS DRILLS) although, progressively, other software was investigated and used.

The initial pilot work consisted of several parts; assessment of language, communication, cognitive abilities and physical abilities, exploitation of any useful physical movement to operate a switch, and the development of a range of individualised switches. Further, there was evaluation of potentially suitable software (that which could be operated by a single switch), and, importantly, staff orientation.

The children who benefitted primarily at this stage were older children who were known to have relatively good cognitive abilities, although perhaps only patchily developed and only partially exercised, because of physical handicap and communication impairment. There is no doubt that microcomputers brought to these children a radical improvement in their self-esteem and in their perceptions of their own abilities, along with a new dimension of independence in their personal communication abilities. Computer-use was largely restricted to the facilitation of communication systems, initially, although efforts were always made to move from this position, to integrate computer-use into classroom routine. Functionally at this time, children, therapists and teachers were exploring new ways of catching up with missed or failed educational activities, and were just beginning to form insights into opportunities for new styles of learning; essentially the operation was one of "Rehabilitation" rather than one of Education or Curriculum Development. Where should computer-use go from here?

2. The Primary Curriculum – Teaching Reading

In attempts to teach reading to such severely handicapped children with no speech, some fundamental problems are highlighted. For example, if an alternative system of communication has to be introduced, such as Blissymbolics or signing, the young child will need considerable time before his/her experience of the expressive side of language and communication develops and reaches some correspondence with his/her experience of the reception of- language. If some balance between expression and reception is not achieved, then the full power of language as communication is not understood or acquired. Language remains merely a Spectator Sport (and the child may often turn to other, behavioural, techniques for manipulating people and the environment.) Teaching reading at this stage would be an empty exercise; very likely the child will fail and in addition might be labelled as having "insuperable" visual perceptual problems or learning difficulties.

Even if children do make progress with building up a reading vocabulary of single words, on a whole word-shape recognition basis, they may become stuck at this level. Because of the notorious difficulties their physical handicap and lack of speech pose to the teacher in assessing how much they have REALLY read and understood, children may be kept at the same level of vocabulary, or the same reading book for so long that they become bored and lose motivation to read. Alternatively, they may be pushed on too fast (for a cleverly-cued smile with an intelligent twinkle in the eye is infinitely deceiving) to the point where they become overwhelmed, and give up through a sense of failure.

Even supposing children successfully survive these stages, when the time comes to extend their sight vocabulary, and move into the use of Phonics, they may founder completely. They may perfectly perceive and discriminate speech sounds *in the speech of others*, but their own phonological system is so underdeveloped and so distorted that building words and sentences intelligibly is a Herculean task. The potential for discouragement is immense.

These are not new problems or ideas for teachers in this field. However, the introduction of Alternative Systems of Communication from 1975 onwards, DID offer new opportunities for language development work, and new experiences in communication for handicapped people. With Blissymbols, early hopes that symbol use would lead to improved reading abilities were never conclusively borne out. Many Bliss children do learn to read, but it has never been proved that their good knowledge and use of Blissymbolics has contributed any more to reading ability than well-developed language and communication facility, in general. Would they have learned to read anyway? And, looking at those Bliss children who do NOT successfully learn to read, one is neccessarily reminded that although their communication is enhanced, Bliss as a meaning-based system, has generally not improved phonological or phonics abilities.

3. Microcomputers – but where is the software?

Microcomputers could supply some of the missing parts that make up the puzzle of learning to read. For instance, even on the most general level, it is now well known that the computer can stimulate attention and motivation, and can give immediate and consistent feedback. Particularly important for P.H. switch users, it can give a new chance of independent control, which in a learning setting can reinforce exploration and experimentation, reducing fear of failure and increasing the experience of success. However, much software has seemed to be of the 'Drill and Practice' type, either based on very early learning levels of shape and colour discrimination activities, or based on text, letters or spelling, beyond the range of pre- and early readers.

What was required was software which could redress the balance of the difficulties described in Section 2 above i.e. software which could offer:

a) An experience of expressive use of language, to build up the correspondence with receptive language and to give experience of independent communication.

b) A rapid, easy way for the teacher to assess whether or not words have been correctly read and understood, and to know at which level exactly to intervene.

c) An auditory cue, compensating for the child's lack of speech, and building towards phonics skills. Also, allowing the child to work independently.

Luckily there are centres where teachers and programmers are communicating on these issues, and working together. Developments have followed and programs have emerged recently, for APPLE 11, which are truly "Enabling".

4. SENTENCE SCAN

This program was designed and written at the Nuffield Project, Ormorod School, Oxford
by Patrick Poon engineer/programmer
Prue Fuller teacher
Tim Southgate Head Teacher

Equipment Required:
- APPLE 11+ (64K required, if using S.A.M.), 11e, 11c
- Speech Synthesiser – for 11c, external Text to Speech synthesiser, eg. Votrax Type 'n Talk, or PS System, or Microvox or Braid. For 11+ OR 11e only S.A.M. (Software Automatic Mouth), a software-driven voice with good tone and inflection, cheaper than external synthesisers.
- Single Switch, connected to Games Paddle output
- Printer with graphics capabilities, eg. Epson FX80

SENTENCE SCAN is a powerful, completely Content-free program; the teacher and user fill the structure with whatever vocabulary/reading exercises, or spontaneous 'Free Use' language they wish. The program will hold 20 exercises of 12 words each, and the content of these can be altered easily at any time. The user chooses appropriate control settings; one or two switch operation, user-stepped or Auto scan, rate of scan, with or without click accompanying scanning, and with or without synthetic speech output. The choice of exercises and settings is then displayed on the screen, with the words listed in large, clear, lower case letters. The cursor scans each word in turn, and when the child hits the switch, the selected word is transferred to a display line at the bottom of the screen, and spoken out. Thus a sentence is built up word by word. When a full stop (or question mark or exclamation mark) is added, the sentence is finished, and slowly appears and is spoken out word by word, scrolling from left to right across the top of the screen. It is repeated as a whole sentence and then printed out in large letters.

This program is working at the level of word-recognition, and can be used for reading work, sentence-building work and communication in general. Because the keyboard is not used, the variables of physical ability and/or keyboard familiarity are eliminated, and the task is broken down into easily manageable steps, each with its own immediate visual and auditory feedback.

To illustrate ways of using the program, a description follows of an actual user, a boy of six years, here called Callum.

5. Callum and SENTENCE SCAN

Callum is a lively little boy who has strong social and communicative drive. He has severe dyskinetic cerebral palsy, he cannot walk or talk, and is entirely dependent on others for feeding, dressing, toilet etc. He can also be distractible. He has learnt effective techniques for manipulating adults to do what he wants, but has had, until recently, poor relationships with his classmates. Callum communicates with Blissymbols, using his thumb to indicate, with gradually increasing accuracy. He has an APPLE 11+ computer, with Votrax speech, and printer, in his classroom for his own personal use, as a communication aid.

It took many months of assessment and trials to establish a switch which Callum could use with speed and accuracy. The movement of his left foot was found to be more reliable than any upper limb movement, and had a less unstabilising effect on his overall muscle tone and positioning, and on his head posture and eye-gaze. The current switch is a paddle switch, mounted backwards-facing on a strut of his wheelchair. An elastic cord attaches the paddle to a hook on the back of Callum's boot; when he kicks his foot gently forwards, this pulls the cord and activates the paddle switch. It was found to be important that Callum was not restricted in his movements by an 'end-plate' of some sort, which tended to set him off into extension or excessive dyskinetic movements, and this was why the 'pull' system was preferred to solid switches to touch or kick.

He had used the computer for a year, for Bliss work, operating a Turtle, games, counting, and latterly, word-matching. A recent change of school, with signs of a new learning phase, heralded the beginning of a reading programme.

Unlike the previous, older, APPLE users, Callum was approaching reading with no sense of previous failure, but as a normal part of the Primary 1 curriculum, at the same age as normal peers. The computer was to be used simply as a tool to give Callum access to the Primary Curriculum, and it is only one part of a whole set of materials, which include word-cards, Blissymbol cards, (covering the same vocabulary, and much more), magnetic bricks moved around on a metal 'blackboard', a reading book (LINKUP), and his own News, Exercise, Drawing and Sentence books. The aims of this sub-part of a larger project can be summarised as:

a) Teach Callum to read.

b) Explore the potential of integrating a personal computer into the classroom.

c) Evaluate the available software for eventual integration into the curriculum, and for curriculum development.

SENTENCE SCAN was introduced to Callum first without the voice (from necessity, not choice), and produced very little positive response, although Callum did understand the task and attempt to do it. But when the voice went on soon afterwards, he immediately became very enthusiastic, and has sustained good attention and interest throughout. At that time, he had virtually no reading ability, so he really was 'learning by doing' (not being 'tested' as so many computer programs seem to do); he knew the computer could say 'Callum', and with very little prompting, he started systematically selecting each word until he found 'Callum' repeated back to him. He then deliberately selected Callum repeatedly. He clearly loved the autonomy the auditory feed-back gave him, and loves printing out hard copy of his own work.

Three months later, Callum works in a number of different ways, using the same versatile program. Sometimes he gives his news in Blissymbols, which are then written out in words, which he scans, selects, and prints: in this 'Free-Use' mode, the fact that the written vocabulary may be unknown to him is counterbalanced by the motivation to print out his own, meaningful news. Often he does sentence-building games or exercises with cards or bricks, then SENTENCE SCAN is used to reinforce and complete this work. For him, it's a reward to hear and print his own work, and an important part of his development to get used to carrying through a task to the end, himself. For the teacher, it's an extra check that all the vocabulary is known (the words can be jumbled up to test this), and extra reinforcement and a permanent record and checklist of his work. Callum knows how to backspace over his mistakes, and built around this is a hidden aim – to bring him up as a child who does not work with the terms 'wrong' (i.e. 'failed'), but only with 'try that again'.

He is well into his reading book, which he is fiercely devoted to, and can operate the computer to 'read-out loud' through it, page by page, as a normal child would do.

Callum loves stories, and recently has become interested in imaginative story games. Building round the language on the pages of his reading book, he will "become" the "lorry driver" or the "shop-keeper", and play out this role. He will turn to the computer as a tool which can help him participate actively in such games. So, when he was playing the lorry-driver, buying a paper in the paper shop, he pointed to the other shop on the page (a fruitshop), and gestured to the computer. He wanted the same pattern of words, for asking for items in a shop, 'I want 'x' please", put in to the computer, so that he could extend the game to the fruit-shop. Subsequently, he enjoyed playing with real fruit and plastic money, but the essence of the game was spontaneously set up by him, using only imagination and the computer.

He has become more independent and imaginative in his communication generally; instead of repeating stereotyped sentences like "Daddy (and) I went (to the) shops (in the) car" in Bliss, he is producing stories about parties, accidents, visits and other happenings, often fictitious, or projecting hopes for the future.

Overall, the synthetic voice on the computer is used mainly in two ways. Firstly, as a reinforcement (i.e. as receptive language) that the chosen word is indeed the one Callum meant it to be, and as auditory reinforcement for the visual, orthographic symbols. Secondly, it is used as a 'Dictionary' for Callum to find out the meaning of words he does not recognise and cannot read. It is not generally used as expressive speech as such, and it is NOT referred to as 'Callum's voice' in any way . . . it is quite definitely the computer's voice. However, Callum is just starting, occasionally, to play with the voice, using it in a more expressive mode. He was amused by the way it pronounced "bananas" (usually, weird pronunciations are noticed, giggled at, accepted and forgotten; it is hoped that an updated version of the program in the future may contain an error trap for odd pronunciations, to allow the teacher to choose the spelling of the word on the screen AND the spelling of the word which will produce the appropriate pronunciation, should the two be different). Someone made a joke about Callum "driving everyone bananas", which also amused him. He then deliberately and repeatedly chose "bananas", consciously attempting to attract the attention of all the others in the class to his joke. Interestingly, apart from the first day and such deliberate acts, the other children in the class are not disturbed by the voice on the APPLE; although they are all highly distractible children, they quickly habituated completely.

6. WRITE and WORDSCAN

These are complementary programs to SENTENCE SCAN.

WRITE is also produced by Patrick Poon and the Nuffield Project team, Ormorod School, Oxford. It requires the same equipment as the SENTENCE SCAN. It is a reading and writing program (using keyboard) which works at a word-building, phonics level.

WORDSCAN is designed and written at the ILEA Resource Centre for Motor and Associated Communication Handicaps, Charlton Park School, London

by	Peter Head	teacher/programmer
	Ruth Boxall	teacher
	Edna Nicol	Head Teacher

This program uses some of the routines written by Patrick Poon, and is standardised to the same presentation format as SENTENCE SCAN and WRITE, so classroom management is easy. It requires the same equipment as the other programs and works as a multiple-choice, question-answer exercise book replacement program.

Callum cannot use WRITE, as it is keyboard based, but since it is content-free and constructed to exactly the same format as SENTENCE SCAN, the teacher can quickly swop the disks over to let other children in the group participate, using the same vocabulary and sentence structures.

Callum sometimes works in a pair with Emily; he chooses words and sentences and she spells them out, using WRITE. The program gives auditory prompts and feedback letter by letter and word by word, so Callum is at least witnessing this practice in phonic building and spelling, actively, since he controls the vocabulary and therefore his own interest. Indeed, he has shown growing ability with letter-sound matching, and the beginning of phonics, and has even started articulating some of the sounds, although speech as a functional primary method of communication is extremely unlikely for him.

WORDSCAN is also operated by a single switch and has speech output. Callum will probably move on to this program soon, (some of his older schoolmates already use it). The teacher sets up a set of questions with short answers, and the child scans through a list of possible answers, selects the one he/she wants, confirms or corrects it and then the computer prints it out. The child can be set up with a personalised lesson, composed of several sets of questions and exercises, and can be left to work through them as any child would, sitting at a desk with a workbook.

The computer does not check or correct the answers, but prints the child's choice of answer.

These are complementary programs and may all eventually lead to the MACAPPLE program (by Patrick Poon). This is a full scale word-processor which can be operated by two switches, and which includes word-lists, a calculator and speech output. In the early stages Callum will use it for drawing and as a sentence-building and language-learning tool.

He will select a word from each appropriate column in the word-lists, to build up SV, SVO, SV Adj O etc. sentences. Ultimately, it is hoped that Callum will be able to construct text letter by letter, personalise his own word-lists, edit, store and retrieve text, format the printer, lay out sums and calculate. Finally, if he can master those techniques, he could use a full-scale keyboard emulator, which could allow him access to any, unmodified, software for computers.

7. CONCLUSION

Fifteen years ago, that would have been an impossible dream. Five years ago, when Callum was a baby, it was known to be possible, but only a few individuals could have access to the specialised equipment necessary. Now it has become a routine part of Callum's classroom day. He has barely known anything different, in his school career so far, and accepts this mixture of Blissymbols and reading, synthetic speech and computer printout as his own particular brand of communication and learning. He is making good progress, and expectations are higher for him than they might have been for any similar child, previously.

The greatest step forward so far is the enlightened and skilful team design and programming that brought SENTENCE SCAN, WRITE, WORDSCAN and MACAPPLE. The next step is to develop and refine the teaching techniques involved, and to firmly integrate these new tools for reading and writing into the curriculum, so that ALL children can tackle Primary Education with the best possible opportunities of success.

NOTES

The SENTENCE SCAN and WRITE programs were produced at Ormorod School and funded by a grant from the Nuffield Foundation. They can be obtained from
Ormorod School
Waynflete Rd.
Headington
Oxford
The cost for each is;
£3.00 (photocopying the manual) plus
£1.00 (postage and packing)
= £4.00 TOTAL
Please also send *2 Apple Disks per program* with your cheque, made payable to "Ormorod School".
MACAPPLE may also be obtained from this address. Please write for details.
The WORDSCAN program was produced at ILEA Centre for Motor and Associated Communication Handicaps.
It can be obtained from;
Inner London Computing Centre
John Ruskin Street
London SE5 0PQ
Cost; £10.00 (disk, manual, postage and packing)

The Interactivity of Cal Software by Robert Ward

Department of Computing, Trent Polytechnic, Nottingham.

1) INTERACTION: A working model

The concept of interactivity appears again and again within the context of educational computing. It is used to commend particular CAL products. It is said to be the one quality that distinguishes CAL from other educational tools. But what exactly is interactivity?

Interacting parties act reciprocally. This not only implies that interacting parties are able to act, but also that they are capable of being acted upon, i.e. they must be able to react and be modified through interaction. Presumably therefore, an interactive CAL program allows the user and the computer to act upon and be modified by each other.

From this, a simple CAL dialogue can be seen to consist of four interrelated components: the user's actions, changes in the computer, the computer's actions and changes in the user. These may be modelled as a circular chain of events in which the initiative in the dialogue passes back and forth from user to computer across the human-computer interface (fig. 1).

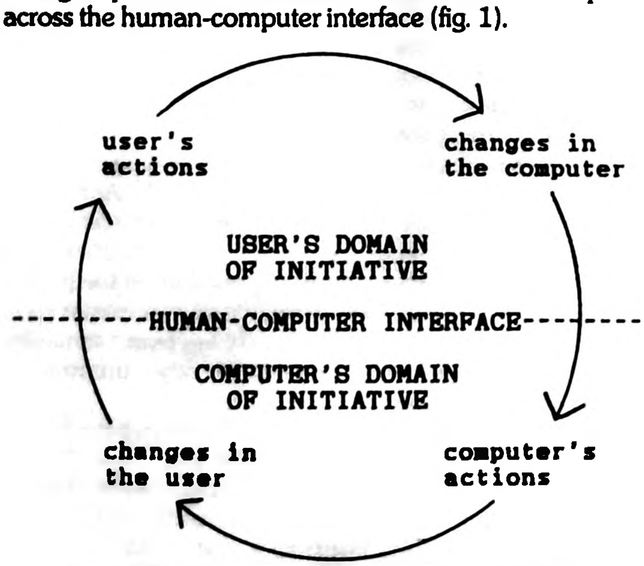


FIGURE 1 : A MODEL OF CAL DIALOGUE

It might be argued that the human-computer interface ought to be represented vertically rather than horizontally, thereby separating human behaviour from the computer's behaviour. It appears horizontally in the model because the criterion for positioning the interface is the balance of initiative in the dialogue. With different criteria, the interface might be situated differently.

The user's actions and changes in the computer are both shown on the user's side of the interface because both are seen as taking place within the user's domain of initiative. The user's actions are seen as controlling changes in the computer. Similarly the computer's actions and changes in the user appear within the computer's domain of initiative. Although the current consensus view of child development stresses the responsibility taken by children for their own learning processes, it must be remembered that the environment is not completely passive, and that CAL users can be seen as being to some extent acted upon and modified by the computer. However the transition between the two stages within the user is probably gradual and less definite than the other transitions.

Clearly interaction in general is more complex than the model shows, particularly interaction between two or more human beings. The sequence of events is rarely so regular, and extra factors are present too, such as assumptions about other participants. But the model adopted is useful because it simplifies interaction into four components which may be considered individually.

2) Changes in the User

Changes in the user are the whole focus of CAL software – its aim is to maximise learning. Dialogues may be considered from this viewpoint alone, for example Kemmis et. al. (1977) identify and discuss five qualitatively different kinds of thought resulting from using the NDPCAL programs: recognition, recall, reconstructive understanding, intuitive understanding and constructive understanding. Similarly, Malone (1981) has suggested that programs that evoke a sense of challenge, fantasy or curiosity can produce high motivation. It seems likely that a user can to some degree control his or her own thought processes by choosing exactly how a particular program is used, just in the same way as one can select one's own learning methods whilst working from a book. But Kemmis et. al. and Malone are saying that in principle programs do influence the user's mental processes.

Our knowledge of the process of learning may never be sufficient to be able to specify precisely how CAL programs can manage changes in the user so as to maximise learning. Human behaviour is difficult to predict, and there will always be alternative and sometimes contradictory theories. But it seems reasonable to generalise that learning depends on substantial interaction with the environment. Thus the remaining three components of CAL dialogues: the user's actions, changes in the computer and the computer's actions; are essential to and instrumental in the learning process. They define the interactivity of the CAL dialogue.

Whereas changes in the user perhaps depend in part on the user himself, the other three components are circumscribed by the computer and its software. The user's direct actions upon the computer are only free to take place within a preprogrammed range of alternatives. Similarly changes in the computer and any initiatives it then takes also depend upon the programming. Thus the user's actions, changes in the computer, the computer's actions, and through them the interactivity of CAL software, are controllable.

3) The Computer's Actions.

As yet, microcomputer based educational software takes few initiatives in dialogues with users. In fact much successful software is completely passive. For example, Logo and other microworlds and many databased approaches simply respond to their user's instructions. Drill and practice programs often appear to take initiatives because they totally control their dialogues, but this is hardly true interaction. They make few decisions, and their presentation sequences do not take much account of their user's behaviour. Only software that adapts in some way to the user's behaviour by making decisions before it acts can be regarded as taking initiatives. In fact the microcomputer programs which at present seem to have the best minds of their own at present are computer games such as chess, or even Defender, in which the user competes against the computer.

This is not to say that any predetermined sequence of actions by the computer is unimportant. Referring back to section 2, Kemmis et. al. (1977) go on to discuss what sort of program leads to what sort of thought process, for example that microworld simulations lead to intuitive understanding. Malone (1981) suggests a set of guidelines about how computers can create the senses of challenge, fantasy or curiosity in their users. For example he suggests that challenge can be produced by setting goals that involve some degree of uncertainty, such as variable levels of difficulty, stages of achievement, randomness or hidden information. The introduction of goals can, within the framework of the current model, be considered to increase the interactivity of the learning situation by balancing the user's freedom of action. The introduction of worksheets and specimen procedures into the Logo experience by the Edinburgh Logo team (Howe and Ross, 1981), can be said to have increased interactivity, although in this particular case the goals were external to the computer, which therefore begins to stretch the simple four part model of interaction that has been adopted.

There may however soon be programs available, particularly on the next generation of microcomputers, that do take substantial initiatives in dialogues. Kowalski (1983) for example, has suggested that Prolog dialogues should be symmetrical between user and system. If the user asks something either unclear or unknown to the system, then the system should attempt clarification by beginning to ask questions of the user. Within this initiative, the user should be able to enter a further level of nesting by beginning to ask questions of the system; and so on. At a simpler level, Bartram (1983) has incorporated similar facilities into an "animals" type program in which the user has to guess an item selected by the program from a database. If the user asks something like "Is it a penguin?", and the database contains no entry for penguin, then the system initiates a sequence of questions in order to add penguin to the database before returning to the original conversation.

Research into intelligent tutoring systems suggests further possibilities. These contain knowledge not only about particular subject matters, but also about alternative teaching strategies and about their users as individuals. With this knowledge, systems can adapt their dialogues to the particular needs of particular users. This might involve altering the interface input methods selecting suitable materials for presentation or offering advice about matters such as problem solving strategies. For example, if the system recognises that the user is having difficulty with a cloze type task, it could switch to a multiple choice interface which is less ambiguous. Similarly the system might select easier or more difficult materials according to the user's past and present performances.

Current school hardware of course, simply does not have the power to provide such facilities, and programs on the market are therefore comparatively small. One well known sentence unjumbling program comes with just three files of materials providing a total of 88 sentences which are not structured in accordance with any recognised language teaching scheme. In comparison, a similar program, as yet not on the market, is associated with thousands of sentences, structured according to the LARSP developmental analysis of language, and occupying four 100k discs (Rostron and Sewell, 1984, ch.11). To use these materials with cassette based computer systems would involve unacceptable file searching delays, and they would be expensive to market on either cassette or disc. Adaptable interfaces and programs associated with large quantities of materials probably therefore need to be distributed electronically, both at the national level through electronic publishing, and the local level through local area networks.

Systems capable of offering advice about problem solving strategies and other matters have also been mentioned. With one such system based upon a mathematical board game called WEST, Burton and Brown (1979) found that students preferred the intelligent coaching version to a version with no coach. The authors put forward the interesting hypothesis that students may some of the time have been engaged in the meta game of "psyching out" the intelligent coach in order to discover the conditions under which it would intervene to offer advice.

Software capable of taking its own initiatives is largely yet to appear beyond research applications, and most existing CAL software can therefore be considered in terms of the two remaining dimensions alone: the user's actions and changes in the computer. Figure 2 tentatively plots existing software types upon these dimensions.

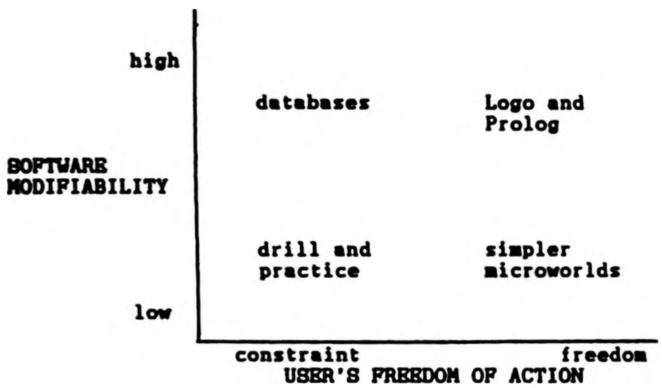


FIGURE 2 : USER'S ACTIONS AND SOFTWARE REACTIONS IN EXISTING CAL SOFTWARE FOR MICROCOMPUTERS.

The vertical axis represents the computer's reactivity in terms of the amount of information it acquires at run-time. The horizontal axis is the so-called freedom and constraint dimension; that is the degree of choice of action a program allows its users to have. The positions of the types of software shown would vary from program to program, but the concept serves as a framework for considering existing software types.

4) The User's Actions

User's tend to have least freedom of action in drill and practice style programs, the archetype of which constrains the user to one kind of activity, allows only one "right" answer to its questions and presents its materials in a fixed sequence. There is however no reason why the adaptable interfaces and the sequencing of materials mentioned in the last section should not both be under some degree of user control too. Also programs now exist that where appropriate allow alternative answers, and authoring languages such as Pilot facilitate the incorporation of alternatives.

Databases too (i.e. databases for use on microcomputers by schoolchildren) tend to constrain the user's actions. File creation is often menu driven so that filenames, field headings and actual data must be input as directed. This data formatting tends to preclude the asking of unanticipated questions. In the original animals program, where the computer guesses items in the user's mind, only yes/no answers are required for much of the time. Of course these restrictions apply only to how the user enters and retrieves information and not to the information itself. The value of databases depends upon their integration into information based activities away from the computer, or, as in animals, upon their requirements for the user to construct increasingly subtle questions and distinctions.

Future databases for schoolchildren are likely to allow their users greater choice of action. For example in one well known animals type of program, instead of the user having to respond with a single word guess to prompts of the type "The answer to the question 'Does it have feathers?' is NO. Your guess is?", it would be better if the user could ask questions directly. Prolog databases do provide this kind of facility to some extent, but the insertion and retrieval of information requires mastery of a convoluted logic based syntax such as "Which ((x year y) (x date y) in USA and 1929 LESS y and y LESS 1936)" (Ennals, 1982 p.134). The use of natural language interfaces will allow more natural dialogue to occur, and commercial database packages along these lines are now beginning to appear.

Microworlds tend to allow greater freedom of action by their users, mainly because they are designed to promote exploratory learning. The commands for Logo in particular can be combined in an infinite number of ways. There are however smaller microworlds, such as programs that deal with water jars problems, in which users are constrained as much as in some drill and practice programs. In fact the two types can be said to overlap.

Natural language interfaces would also be useful with smaller microworlds. For example microworlds constructed out of Logo, such as Beach (Lawler, 1982), can have limited application if they allow only unitary input corresponding to Logo procedure names. Adventure type microworlds too would be better if they did not restrict the user to terse imperatives such as "North" or "Take lamp". In this area the present author has developed several microworlds for the BBC computer that allow the user to hold written dialogues with the computer about objects on the VDU screen (Ward et. al. 1983, and in press). The dialogues are near-symmetrical and include descriptive, imperative and interrogative sentences. A typical exchange might go as follows:

User:	Is my blue cross the same height as your diamond?
Computer:	No, your blue cross is smaller than my diamond.
User:	Make my blue cross smaller.

Discussion of the user's actions so far has been concerned mainly with standard keyboard input, but other possibilities should also be mentioned. Speech recognition, iconic menus with mouse pointers, touch sensitive screen or keyboards, light pens and even image processing are likely to increase the possible range of users' actions in the future. Also activity away from the computer has been touched upon in the context of databases. Many programs stimulate interaction between people, for example cooperation with and competition between teams of pirates and treasure hunters. Other programs demand substantial reading activity away from the computer. These too should be mentioned in the context of user's actions, although this again extends the simple four part working model of interactivity that has been adopted.

5) Changes in the Computer

Just as the user's actions can be effected through a variety of input devices, they can cause changes expressed by a variety of output devices. The movement of a turtle, either on or off the screen, is a user-initiated change in the state of the computer. Speech synthesis and control technology might also be mentioned here.

Changes in the computer can also be internal ones, and therefore this section is also concerned with the information acquired by the computer during the execution of a program. In drill and practice programs and the simpler microworlds it tends to be little, although sometimes these software types do record summary data about the user's performance. Mainframe drill and practice software may keep substantial records of the user's performance, but microcomputers usually devote most of their available power to the program and its associated materials. However, intelligent tutoring systems will require detailed information about the user's behaviour in order to construct the models upon which teaching decisions are based.

Databases, Logo and Prolog are more modifiable than the drill and practice type and the simpler microworlds because they store information as an inherent part of their operation. In Logo the stored knowledge tends to be procedural and in databases it is usually factual. Prolog might be regarded as storing both factual and procedural knowledge.

One of the present limitations of microcomputer databases is the quantity of information that can be stored. A typical database for the BBC computer has a capacity of around only 70 ten field records or 250 two field records. These figures will increase as more powerful hardware comes into use, in the same way as will the quantity of teaching materials associated with programs.

A second limitation of existing software is the flexibility of stored information. This tends to be low at present because of the way in which stored information is structured. In the animals program, the reason why the user cannot ask direct questions about the attributes of items is that the tree structure employed to store the data makes information about attributes difficult to retrieve. Logo and Prolog are more flexible databases because they in effect structure their data in a way defined by the user, but this flexibility is obtained at the expense of reducing the quantity of information that can be stored, and the speed with which it can be retrieved.

6) Concluding Remarks

A number of aspects of interactivity in CAL software have been discussed within the framework of a four part model of CAL dialogue. The model has been shown to be inadequate in some ways, but it generally seems to have served to clarify what it means to describe a CAL program as interactive. Interactivity can be said to be a result of the abilities of both the user and the computer to select their own actions, and to interpret the other's actions within the dynamic framework of their own mental structures.

What appears to be emerging is a repertoire of techniques and approaches for making programs interactive. The elements may have diverse origins: databases probably in business applications; drill and practice in programmed learning together with its relative ease of implementation; Logo in Piagetian psychology; Prolog in formal logic; microworld adventures in the dungeons and dragons game; the animals program in computer science; natural language processing in artificial intelligence and so on. But they can now be considered together under the general heading of CAL techniques. Future applications of this existing repertoire will be enhanced by greater computing power, and new ideas, especially from the area of artificial intelligence research, are likely to be added. If these developments occur, the simple circular model of interactivity is likely to appear increasingly inadequate.

The desirability in educational terms of using any of these techniques has not been discussed. Partly, as was mentioned in section 2, it is difficult to determine the educational effectiveness of any learning methodology, especially as every topic area and every group of students have their own particular characteristics. Sometimes drill and practice exercises will be most appropriate, and at other times more inherently meaningful microworld simulations might be preferred. But knowing what techniques are available is a start to the development of educational theories about CAL along the lines of Kemmis et. al. (1977) and Malone (1981).

Nor has the materials content of programs been discussed, but one would expect to see in the future more materials based upon previous research into education and developmental psychology, along the lines of Rostron and Sewell (1984). It is in fact surprising that so little software makes use of the large amounts of materials so carefully developed without computers in mind, but that are suitable for use with computers.

Interactivity for its own sake alone is perhaps rarely desirable. The degrees of user freedom and computer decision making, and the storage of information by or about the user should not necessarily be at a maximum in every program. Just as Howe and Ross (1981) considered it necessary to reduce the user's freedom of action with the introduction of external goals, the design of CAL dialogues involves making selections from the available techniques in order to create balanced learning experiences.

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Making Micro Map – a Case-study of the Development of a Software Package by Tony Gray and Carl Billson

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Making software is a creative process. This case-study attempts to illustrate this process, and show the range and depth of thinking that goes into the development of computer-based learning materials. It concerns a software package designed to help primary-aged children learn and practise map-work skills: Micro Map.(1)

In the course of developing a program, many decisions are made by the authors which have direct bearing on the style of the material, the ways it may be used and, of course, the resultant learning. The interplay of these decisions determines the effectiveness of the material in the classroom and it is hoped that reading the case-study will give insights which will help when evaluating software.

The Micro Map package centres on the imaginary village of Ferndale and comprises: paper maps of Ferndale in different scales, 12 work sheets about places in Ferndale, a 360 degrees protractor, the teacher's notes and two discs (or cassettes). It was developed over a period of nine months by the Primary Micro Project in the Education Department at Loughborough University, and involved considerable assistance from many schools.

Why Map-Work Skills?

Most people find maps fascinating. They are a unique way of showing spatial information, and knowing how to read and interpret them is an important life skill. Maps can also give pleasure; reading one can be like actually sitting on a hill-top looking down at the landscape stretching away below.

Teachers recognise these points, the literature supporting the view that using maps, pictures and diagrams effectively constitutes one of the 'four main orders of comunication – Literacy, Numeracy, Articulacy and Graphicacy'.(2) In the course of our work, many teachers mentioned map-work skills as an area with which they would appreciate help. Could the computer be of use?

In our view, map skills are best acquired 'in the field' through first-hand experience of a familiar locality. Consequently, we decided that our aim should be to design a resource which modelled field-work, thereby providing ready transfer of learning from a micro-world to the real environment. Such modelling would imply using a paper map since this is the form in which most people encounter maps in everyday life. Another important principle was that the program should not attempt to teach; rather it would provide a context for practising map-work skills.

We began by asking two questions: What are maps like and what skills are involved in reading them? The introduction to Micro Map summarises our view:

> A map is a complex document, with its own conventions and containing information in a particularly concentrated form. For example, a single small portion of an Ordnance Survey map may contain details about height, size, position, function, distance, terrain, orientation, relationship to other areas and so on. Consequently, to get the information you require from a map – reading for meaning – involves selecting, sifting and interpreting; all of which are higher-order reading skills.

To employ these higher-order skills children also need to understand such concepts as scale, grid references, bearings and so on. Our job was to create a resource which would require the children to use these skills.

Our first idea was to base the program around some activity that required map reading skills; orienteering for instance. As happens in everyday life, this active approach would integrate separate skills into a single activity.

We discovered a program designed for orienteers called 'The Forest'(3) which is an effective simulation for practising orienteering skills. Simple graphics show the view ahead as you 'run' in search of the control points, and we were confirmed in our view that moving around a computer-modelled landscape was the approach to pursue. However, an orienteering-type program presupposes a large number of skills: excellent as a context for integration but not suitable for younger children still learning.

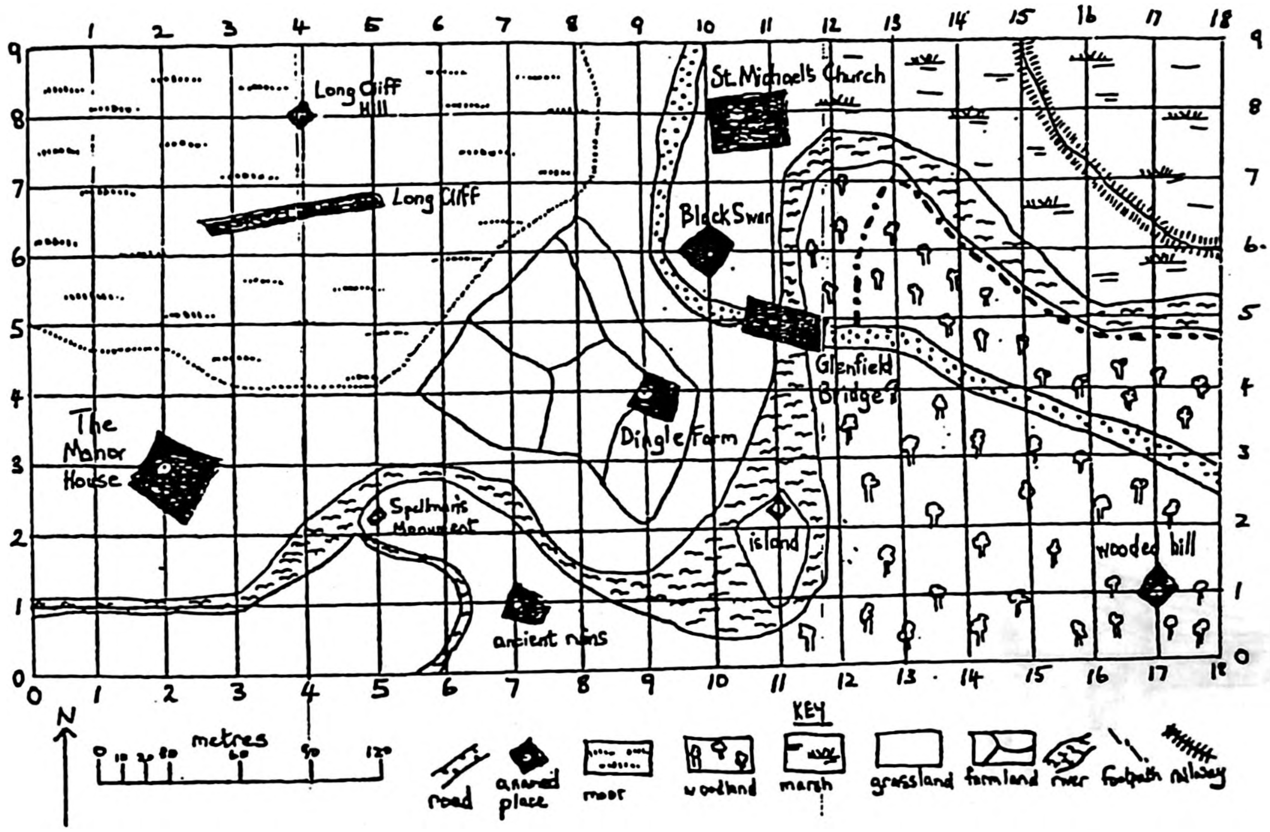
Our survey of programs continued, all the other programs we looked at having maps drawn on the screen. This has major disadvantages: most maps in use in the world are on paper and are easily transportable for use in cars and so on. Using maps may involve turning the sheet to help with orientation; people write on maps to measure angles and distances, mark routes and so on. You need a paper map to practise these things and we decided to stand by our original decision to have a paper map, the computer screen showing only text.

Our review of the literature and existing software being complete, the next stage was a feasibility study. There is always a conflict between what can be achieved on a micro and what you'd like to do. Compromises become inevitable and in order to minimise these and maintain educational rather than technical priority, test programs are written. In this case, it was crucial to know whether a sufficiently large yet detailed map could be held by the micro as data.

These criteria were adopted for the test program:

- the area shown on the map would need to be large enough to have an interesting variety of terrain;
- the program would need to interpret the map in sufficient detail that bearings would be accurate to the nearest degree and scale distances to 2mm on the map;
- exercises using the map would involve points of the compass, scale and distance, grid references, and using the key.

Our initial effort was a series of exercises based upon the map shown below in reduced scale:



This map includes some geographical howlers but brief trials in school established the viability of our approach. The program stored the map as data (over 16000 individual positions on the map) and the computer screen was used for text. As required, the exercises involved grid references, points of the compass, scale distances and interpreting terrain.

Feedback from children and teachers concerning this first version of the progam, resulted in much useful information which guided us during the next stage.

The Design of the Map

Making up a map sounds easy. Making up a map which will give the maximum number of opportunities for learning and extension into other work is not easy. Look at the map of Ferndale. It is eight generations on from the first map above. Everything about it has been debated, justified and tested – several times. And of course, we started with a blank sheet of paper!

Before deciding upon the detail of the landscape there were several key issues to consider:

- How might the program be used in school?
- Which scale is most appropriate?
- What features should the map contain?
- Should the map include contours? (at that time part of the database)

The dominant considerations were practical. We wanted teachers to be able to provide every child with a paper map which they could measure from, draw on and colour. The easiest solution seemed to be to provide a black-and-white map on A4 sized paper that could be readily copied. This imposed certain design constraints, notably how to squeeze everything onto one page whilst still giving the printers their 2mm leaway! (Interestingly, all A4 is not quite the same and the publishers were able to buy "large" A4 which helped us.)

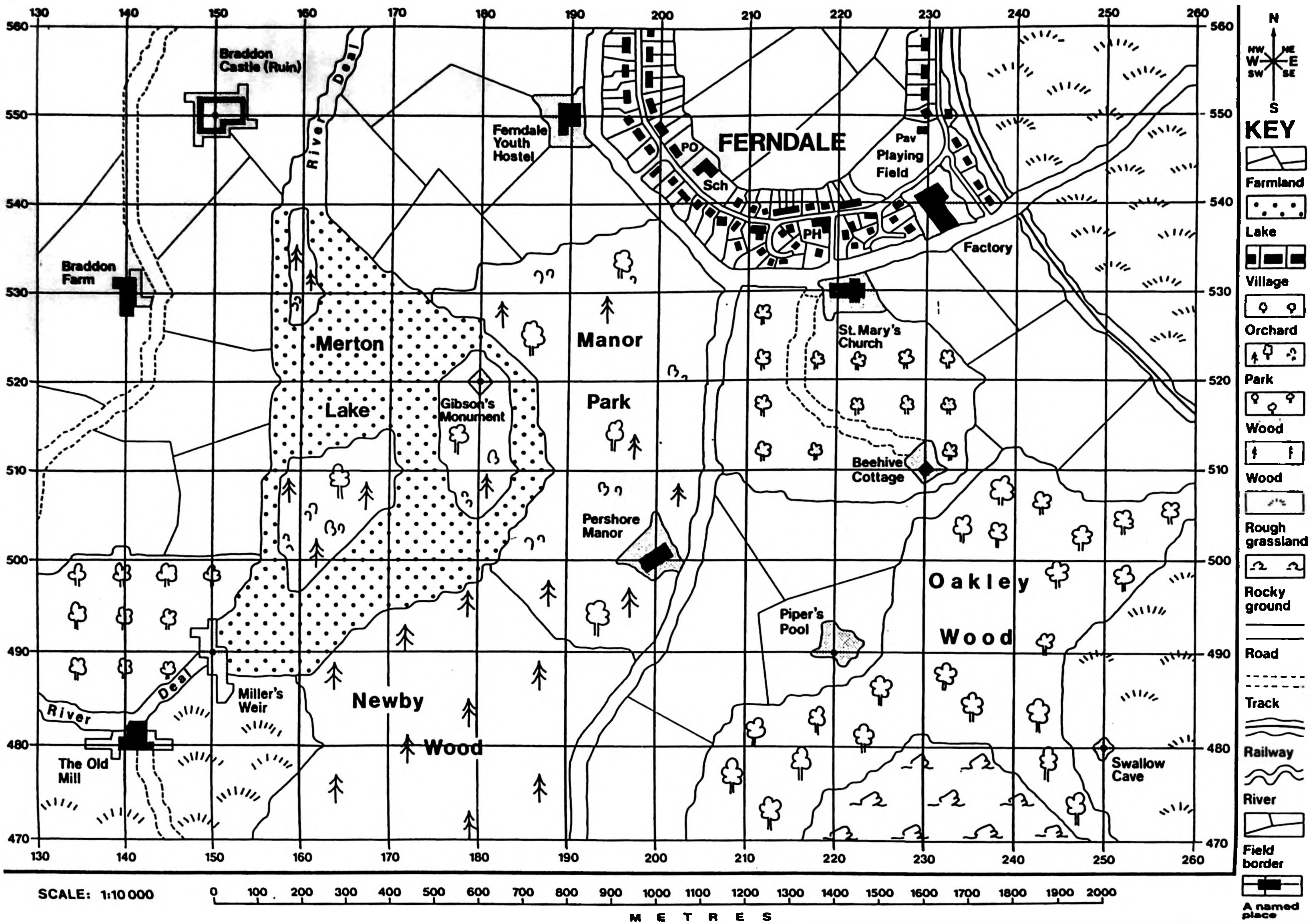
Which scale would be appropriate? It was important to follow Ordnance Survey standards since O.S. maps are ones the children often come across and need to use. The 1:10000 scale seemed best on four counts:

– at this scale individual buildings and roads are marked, and this would help children to visualize the place;
– the simple ratio makes scale distances relatively easy to manipulate;
– O.S. maps of this scale are also in black-and-white (except for brown contour lines);
– the area represented on an A4 sized sheet allowed a sufficient diversity of terrain to enable variety in exercises.

However there was a difficulty. On an O.S. 1:10000 map, lines of longitude and latitude appear at 10cm intervals (corresponding to an actual interval of 1km). Very few such lines would appear on an A4-sized map to this scale, so, in order to help the children learn the concept of grid references more easily, we decided to have lines at 2cm intervals instead. Here's the reasoning we give in the teacher's notes:

> The Ferndale map has lines of longitude and latitude at more regular intervals than are shown on an Ordnance Survey map of the same scale. Children will quickly notice this when comparing the maps. These extra lines increase the number and range of questions that can be asked using a map of this size. The lines are numbered with corresponding greater regularity.
>
> The lines are referred to by three figure references: for example, 180 not just 18 as might appear on an Ordnance Survey map. This gives the children extra help.

There is a compromise here which is clearly explained. Teachers of primary-age children, for whom the program was originally intended, found this compromise acceptable. However, the latter issue has caused concern among some secondary geography specialists. They maintain that using three figure reference for grid lines increases the potential for confusion when teaching co-ordinates to children in secondary school. For instance, a grid-square is referenced by four figures, e.g. 34, 29.



Braddon Castle (Ruin)
River Deal
Ferndale Youth Hostel
FERNDALE
PO
Sch
PH
Pav
Playing Field
Factory
Braddon Farm
Merton Lake
Gibson's Monument
Manor Park
St. Mary's Church
Beehive Cottage
Pershore Manor
Piper's Pool
Oakley Wood
Newby Wood
Miller's Weir
River Deal
The Old Mill
Swallow Cave
N
NW
NE
W
E
SW
SE
S
KEY
Farmland
Lake
Village
Orchard
Park
Wood
Wood
Rough grassland
Rocky ground
Road
Track
Railway
River
Field border
A named place
SCALE: 1:10 000
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000
METRES

Our view is that it is the concept that is important. After all town plans, road atlases and non-British national maps often have alternative conventions sometimes using both numbers and letters. The key concept is knowing that you can refer to points on a map by using a grid reference. Evidence from schools demonstrates that children are helped by the program to acquire this general concept which once grasped, can be adapted and applied to whatever conventions happen to be in use.

Other devices were incorporated in the design of the map to support children's learning of map conventions. The teacher's notes again explain:

> The map's origin is (130,470). This was chosen to reduce confusion for children who are learning the conventions for using grid references – i.e. x co-ordinate comes before the y co-ordinate. Should children mix up the order, the computer will respond with a message 'No, that's off the map' since the values never overlap.

Incidentally that message is typical of help given throughout the program. It is designed to get children to reflect upon their answer rather than label answers 'wrong'.

Contours disappeared from the map specification at this stage. There seemed to be some justification for this. Primary teachers we talked with believed it was desirable that older juniors recognised in general terms the function of contours, but felt it was more appropriate that they use other symbols, such as arrows to indicate slopes. (The literature (4) also supported this view.) There was a strong consensus that contours were not necessary in planning our range of exercises.

Now we were better equipped to think about the content of the map; the place itself. Ideally, this imaginary landscape should be a place that might just be a few miles from where you live! These were the prime considerations:

- The landscape should be plausible and, for educational reasons, contain an unusual variety of terrain in a relatively small area.
- Map symbols must follow O.S. conventions and include as many symbols as possible for children to experience.
- There would be places and a few special 'Named Places' known by the program and which would figure in exercises. Named Places would have the intersection of main grid lines as a central point for measurements of distance or bearing.
- There should be a maximum of twelve Named Places for the sake of clarity on the map and in screen layout of the exercises.
- Named Places should be well distributed about the map to increase variety and interest in questions involving the relationship of places one to another, e.g. in scale distances and compass bearings.
- One of the Named Places should be positioned in the south-west corner of the map to help early practice with bearings. In the first of a graded series of exercises the Old Mill is used repeatedly, bearings to other Named Places always being between 0 and 90 degrees.
- There should be places that children could readily associate with (for example, houses, a school, church, factory, castle, Youth Hostel), as well as places that allowed for speculation – a monument and a cave.
- Place names should be 'regionally neutral' but evocative of the historical development of the community.

As you can see some of these criteria are specifically designed to enhance learning of particular geographical map skills, e.g. measuring compass bearings. Others were concerned with making Ferndale a living place which can be imagined written and talked about. We develop this theme in the course of describing how the exercises evolved.

The Design of the Exercises

The four exercises devised initially for Micro Map 1 involved basic map-work skills: grid references, using a key, scale distances and points of the compass. School trials suggested ways of improving these, for example:

- Levels of difficulty

  One way of grading the difficulty of questions was to make the program select points involving differing degrees of extrapolation between major grid-lines. Compare, for example, the relative difficulty in locating these three positions precisely: (190,490) (224,550) and (162,548).
- Degrees of tolerance.

  Answers can be considered to be correct provided they are within a certain range. For example in Scale and distance exercises, Level 3 requires answers to be exact; answers at Level 1, however, can be within 60m of the exact answer. Whatever the level, the computer always presents the exact distance.
- Units of measurement

  Answers should always include the appropriate units and the program provides suitable prompts, such as 'Please include the units'. In the Scale and distance exercise, answers may be given as metres or kilometres, the computer responding with similar units but also presenting its equivalent in either metres or kilometres.

As the program developed, we devised additional exercises of greater sophistication. These became Micro Map 2, and the exercises tend to be more open-ended and interpretive. They were tried in schools as questions on Banda sheets and were a nightmare to mark because there was never a single correct answer. For example, two sample questions from the exercise – Where are you?

1. You are on a road nearest to St Mary's Church. Please give your position.
   I am at grid reference (——,——)

   or
2. You are in a wood and to the north east lies Pershore Manor. Please give your position.
   I am at grid reference (——,——)

There are a series of acceptable answers to these questions.

Consider question 1 above. Here are five answers:

(220,532) (190,500) (220,525) (240,540) (532,220).

How would you respond to each answer?

The computer must provide appropriate comments in each case, the messages being designed to encourage the children to reflect upon their answer and to try again.

For example a computer message might be:

> Nearly.
> At grid reference (240,540) you are on a road but the Factory is nearest. Please try again.'

Children can select the number of attempts they wish to have before the computer gives an answer. The computer answer is carefully worded to reflect the fact that there is no single correct answer to some questions. For example, in response to question 1 above, the computer will select a location that fulfils the conditions of the question and suggest it as one possible answer:

One answer might be (215,531).

In general, educational programs reveal their true colours when handling incorrect or obscure answers. Clearly when exercises are open-ended enough to admit several valid answers, there must be several ways of being correct and incorrect. We devoted a lot of thought to giving positive messages which help children learn from their mistakes.

Similarly the design of pages of text was rigorous, sometimes taking half a day over the layout of a single page. Colour, position and repetition of information are just as important as correct use of English, checking the sense of messages and avoiding ambiguity when considering pages of text on a screen. In this way we were able to ensure that children always had the relevant information available to help them answer the question.

Good screen layout should be a channel to the program's content, a channel free from obstruction; and the acid test for a page of text is the Silence Test. If the children use a page and pass no comment of the "What are we supposed to do next?" variety, you've won. The accolade of silence demonstrates that the program is free of the kind of hurdles that get in the way of the children's learning. Time given to screen readability is time well spent.

Ultimately, the five exercises on Micro Map 2 became:

A Which way?	(body orientation)
B Where are you?	(interpreting terrain)
C As the crow flies	(interpreting information about 'walks' across Ferndale)
D Bearings	
E Get out of that!	(pin-pointing your position using triangulation)

The Work Sheets

This wide range of exercises gives experience in geographical interpretation from simple to quite complex activities, but what about historical and more general kinds of map interpretation? Maps, after all, are representations of the 'real' world so we should be able to read from them what places are like now, and also what they may have been like in the past.

Look at the map of Ferndale:

Where might local football might be played?
Which area might be the oldest part of the village?
Which is the most likely place to see an owl?
Choose the place you would like to live.
Consider this portion of an invented 'Historie of Fern-le-dale':

"Swallow Cave was inhabited by monks, moving from the decadent regime of the larger monastry at Bridgeford. The new buildings were erected in Oak Ley Wood. At the Dissolution all trace of these buildings was lost, but the stones were used in the building of Beehive Cottage and the re-furbishment of St. Mary's church, thanks be to my master Lord Edward De Savery of Pershore. The new stables at Pershore Manor also used these stones. The orchards are the remnants of the monk's farming activities and Piper's Pool was once their fishery.

Michael Garland Morris Esquire,
Historian of East Suffolk" (5)

Twelve work-sheets were designed to foster this kind of interpretation which creates a reality from the two-dimensional map. The ideas in them are open-ended and designed to draw parallels between Ferndale and the place where the children live. For example one sheet has 25 pictures of signs and asks where they might be seen in the Ferndale area.

Teachers readily saw the potential in these ideas and extended them. In a drama, one class made a television documentary, a kind of 'Down Your Way' in Ferndale. Several teachers used the maps and work-sheets together long before the children met the computer exercises.

Using the work sheets enables a teacher and her class to move out from the imaginary Ferndale area and consider similar features of their own landscape. Areas which they intend to visit can also be thought about and this led to our most recent development of the idea.

The Utility Disc

Before publication, we needed to check very precisely the final version of the map; all 16000 items of data! To do this manually would have been a nightmare. Also, we decided that it should be possible to allow teachers to create their own maps, thereby enabling Micro Map exercises to be about local places or places to which they intend to take the children. If you are going on a field trip to Derbyshire, it would be very useful to allow the children to practice their skills on the correct map before they get there.

Howard Spellman, who coded the programs, had already created a number of test programs to help him devise and check the database containing the Ferndale map. Discussions led to these being developed into a series of utilities which allows anyone to create a map that can be used instead of Ferndale for running Micro Map exercises. This utility is currently being trialled and will be published in Spring 1985. Response to this extra facility has been good, largely because it enshrines the principle that teachers know best what they need, and our job is to help them obtain that by being flexible in our approach.

Conclusion

Developing software takes time and is a creative exercise involving many individuals and talents. The foregoing is a distillation of this process, describing some of the thinking, development, trialling and content of a complex resource. Thousands of decisions were made over the nine months and we hope that we have been able to give you a flavour of the way these have interacted to produce the final packages. Undoubtedly, some of these decisions were better than others, and we would welcome constructive feedback from anyone who has used the Micro Map programs, in order that we can further improve what we hope is a good resource for primary school mapwork.

References

1. Micro Map 1 and 2 are published by Longman. Ring David Jamieson on 0279-26721 for a free video about using the Loughborough software in the classroom.
2. Boardman, D., "Graphicacy and Geography Teaching", Croom Helm, 1983
3. 'The Forest', Phipps Associates, 1983
4. op cit Boardman, D.
5. Thanks to Mike Garland, Deputy Head at Hadleigh Primary

The Perils of Software Publishing by Brian Kerslake

Brian Kerslake is Joint Managing Director of Chalksoft Ltd – designers and suppliers of Educational Software for the BBC and other popular micros. In this brief article he describes the birth of one of their best-selling programs, looks back on its development, and gives an example of the sort of behaviour that could – if not trodden-on now – kill independent suppliers of educational software stone-dead.

One Monday morning yet another padded brown envelope thumps through my letter box. I finish drowning the cornflakes, rub the sleep out of my eyes, stagger to the door . . .

'Computer cassette. Do NOT X-ray!' is stamped very clearly on the outside. The package looks as if its been chewed by a dog; I guess that, despite the warning, it's been through some sort of GPO anti-bomb screening procedure. I decide the tape will probably never load anyway, and dump it in my 'in'-tray with the other thirty or so hopefuls . . .

It's January 1983, and Chalksoft is just beginning to be noticed. Our tapes are now being distributed to schools by Ward Lock Educational. Reviews – some good, some bad – are beginning to appear in the press, and teachers are suddenly waking-up to the fact that there's money to be made in software . . .

'For everyone who thinks he can write a novel, only one ever sits down and does it. For every one who sits down and starts, only one ever finishes. For every one that finishes, only one gets published . . .'

Software publishing is a bit like that these days. Even back in the heady days of 1983, it was almost as bad.

'Thank you for your submission. I regret that your head needs cleaning'.

'Thank you for sending in your tape called "Tables Invaders"; I regret we shall be unable to publish it, because there are already at least 5 other such programs on the market . . .'

'Thank you for sending in your tape. Whilst the standard of programming is high, we are unable to proceed publication because . . .'

First sight of 'Pictures'

Ninety per cent rubbish, and ten per cent possible pearls . . . But, in the middle of the rubbish is a little black tape called 'PICTURES'. There are several programs on it – some good, and some bad. The title program is fascinating. It's a simple idea; one that we've thought of doing ourselves but never got round to. Using BBC MODE 7 graphics, it draws pictures of everyday objects that children can recognise, and expects the child to type in the word that matches the picture . . .

'Hmm', says I. 'Bit like a flash card. Early reading stuff. Testing spelling a bit early though.' I 'phone the programmer:

'Hello. Chalksoft here.'

'Oh, hello. Did you get our tape, then?'

'Yes. Thanks a lot. I've just been looking at it. There's some good stuff on it . . .'

'Thanks.'

'And some bad.'

'Oh! Well, I'm not a teacher. And neither is my husband!'

Turns out that this good lady, who shall remain nameless, and her husband are computer loonies – her phrase – hubby managing a commercial computer installation while she, an ex-programmer – is presently raising kids and getting to know her BBC micro. 'So we don't know much about teaching. We just sit down and do things that will amuse our kids. Which one do you like?'

I tell her and we discuss it. I explain a few ways that it might be developed. But is she interested in doing any further work on it? She supposes so. She says programming is a bit like having a baby. Once you've had one you don't want to go through it again . . .

'OK' she says. 'Send me some ideas, and we'll knock them into shape for you. What's the deal?'

We explain our standard rate. She will get 20% of whatever we get for the product – and we have to give major distributors discounts that can run as high as 60%.

She consults her hubby – no women's lib. here – and gets a 'yes'. I tell her that we'll get some ideas in the post as soon as we can – within a fortnight.

In fact a month goes by before the memo I write myself finds its way again to the top of my in-tray. Meanwhile another thirty programs have been looked at, reviewed and, mostly, rejected.

Forward to the next stage

My colleagues and I get together for a 'potential product' evaluation meeting. 'Pictures' goes forward to the next stage: drawing-up a firm design specification. That gets delegated to my wife, and she comes up with the idea of displaying four randomly-selected pictures on the screen at the same time, and a word that matches one of them. The input is the problem . . . How do you get a five year old to communicate with the computer?

She hits upon the idea of using the SPACE BAR. Every time the child presses the space bar a flashing arrow will jump from one picture to the next. This cycle will continue until the child presses the RETURN key to signify his/her decision.

But is that the best way of doing it? We wish there was something around like the 'Concept Keyboard' – but there isn't – or if there is, we haven't heard about it yet. Remember this is early 1983.

We consider five other alternatives, do a quick bit of programming to try them out, and decide that the original idea – as it so often is – is the best.

My wife and I sit down to hammer-out the rest of the program. It needs something to bring it alive . . .

One of our kids wanders in, for some reason singing that popular children's counting song, 'Five Little Speckled Frogs'. I rough out a screen design using a frog to the right of the four pictures. I draw ten 'delicious bugs' just above him. I write, 'Every time the child gets a correct answer, Freddie will leap up and guzzle a bug. If he's wrong he'll sit there stamping his feet!'

We decide that the child should be presented with ten words, and not be allowed to proceed to the next until he's 'read' the previous one correctly. We decide the final reward sequence: the complete words and animated pictures to the tune 'Five Little Speckled Frogs'. We draw up a full program specification, and send it off to our pet programmer, now code-named 'Freddie'. I follow-up in a couple of days with a 'phone call just to check we're not asking her to do the impossible . . .

Then we sit down and list OUR problems:

What words to put in the program? Should we match them to one particular reading scheme? Or should we survey the schemes and pull-out the most common words? Will we have to pay royalties on the song? How should we release it? Just on cassette? Or on disc too? The production will be uneconomical if we have to do two print runs – one for a small cassette box, and another for a disc box. We settle for selling all the versions – tape and cassette – in a big white box. But who makes such boxes? Several weeks research before we find the right box at the wrong price – but we'll have to buy them anyway. Yes, of COURSE we can have them in a few weeks They take MONTHS. And shall we convert the program to other machines? How many will we sell? How many wrappers should we print? How-many different machines can we allow for? How many 'freebies' can we give away? Does it need a descriptive booklet? We watch the anticipated production costs spiral as quotes for packaging, printing, cassette duplication, etc, are revised.

Software development goes on

In the meantime, the software development goes on. Every couple of weeks we receive from Freddie another tape with slightly fewer bugs. We hit on the idea of offering sentences to match the pictures too, thus hopefully widening the market still further . . .

We try the program out in friendly schools. While it's being tried Freddie is driving herself nuts converting the program to run on the Commodore 64 and Spectrum. Then all of the ammendments as a result of field trials have to be applied to each of the versions: THAT'S not an elephant; teachers want a performance table; that colour clashes with that one; horrible discord there! All very sensible comments; and all acted upon . . .

A whole year's work

II TAKES A WHOLE YEAR to get that program released. It's January 1984 before we can actually start placing advertisements. It sells slowly, gets the odd review.

'A pity Chalksoft didn't think about the colours more carefully . . .'

'Offering a performance table option is ridiculous! Who'd use such a thing with five year olds?'

'What a pity Chalksoft didn't use the words of Britain's most popular reading scheme, the . . .'

We decide that we can't win, give up reading reviews, release the Spectrum version and the Commodore 64 versions simultaneously, one on each side of the same tape – the idea being to cut down shelf space for a dealer since we hope to get it into the shops . . .

September 1984 and it's starting to sell in a reasonably satisfying way. Freddie celebrates by writing another smash-hit for us but published by MIRRORSOFT. This is 'Caeser's Travels', a follow-up to their 'Caeser the Cat' game for children. We'd proposed it to Mirrorsoft way back in January; it was mid-July when they decided that they wanted it in the shops for Christmas. Panic! But there's money 'up-front' – and with schools so slow to pay . . .

The after dinner surprise

She finishes this job and accepts an invitation to dinner with friends – a teaching couple. After dinner she sifts through her friends' BBC disc collection. And there, in the middle of a pile of chalk-splattered and grubby discs is a pirated copy of 'Words & Pictures', the program we've just spent a year working on!

Next day she rings me: frustrated, angry, torn. She wants to tell us the story, but doesn't want to lose a friend. It seems that her friend – and a lot of other colleagues – were invited by their local Teachers' Centre to bring along their micros and copy-discs.

Her friend had estimated that perhaps fifty copies were taken that afternoon – and there's nothing that she – or we – can do about it, other than write to the County Education Officer and point out the same old tired story, that if teachers go on 'pirating' software, commercial publishers will simply pull out of the field, and that if we can ever pin a school or education authority down we'll certainly take legal action . . .

I'VE TOLD that story in some detail. 'WORDS & PICTURES' really did take a year to develop; most good programs that are developed with the help of teachers do – because testing them with children does take a long time, as does acting on other teachers' comments. 'Pirate' copies really were made; very nice for the schools which received their 'freebies' – but imagine our poor programmer's feelings: literally hundreds of hours work down the miserable drain of inadequate Government funding. What a crazy idea it was to give schools cheap micros and NOT to make the cash available for them to buy software. And isn't it sad that so few teachers appreciate the human effort that goes into producing just one program for schools . . .

Well, those padded envelopes keep thudding through my letter box. These days they sit in my in-tray much longer. Increasingly we're advising authors to put their ideas down on paper before starting the coding; that way we can advise them if there is a gap in the market, and whether or not their idea has potential. This can save a lot of time for both parties.

Nevertheless, nice, nearly-finished programs do still come along. We have a new French set due for release soon: 'Centre Ville' by a skilled programmer with a wife who teaches French. And there's a music learning program called 'Rhythm & Pitch' by the author of our best-selling 'Note Invaders' program. He's a music teacher and an excellent programmeer; 'Note Invaders' arrived in just that way around a year ago . . .

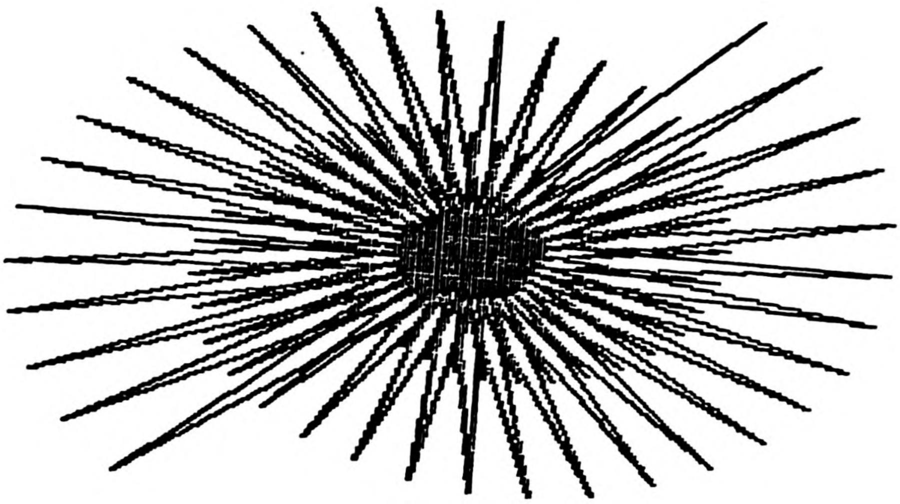
Neither of these authors will make a fortune out of writing educational software; what they should receive – if schools are told to stop copying and enabled to start spending cash – is a reasonable return for their labours, spread over a number of years. They'll make a small side-income too from overseas sales (BBC products are sold in such countries as Australia, New Zealand, and India, with C64 & Spectrum conversions of some titles selling in British shops and on the European mainland).

The threat to the future

So there's no fortune to be made in writing – or marketing – educational software. It's more of a long, hard slog – with a lot of sharks and unscrupulous people ready to pounce at every step. Sadly, these don't only exist in the high-street world of games software merchandising. It appears that there are a lot of them in schools, Teachers' Centres, and Colleges too. Their selfishness is doing nobody a service in the long run, because – in the long run – there may simply be no new quality software produced.

Chalksoft is always ready to consider your software or software ideas, and welcomes feedback from teachers on the design and usefulness – or otherwise – of its software.

But be prepared to spend a long time getting it right! Chalksoft can be found at 37 Willowslea Road, WORCESTER, WR3 7QP tel 0905 55192



The Launch of Logo by Stephen Booth

St. Peter's C.E. Primary School, Bury.

During the First Punic War (263-237 B.C.) the Carthaginian navy was running the Romans ragged in the Mediterranean until misfortune struck one of the Carthaginian galleys. It got itself into difficulties and ran aground on the Roman occupied shore. The Romans proceeded to examine this galley and then to build ships of their own to an identical design but in much greater numbers. From this time on, the Romans controlled the sea, and history records the result.

Bury is a late starter to introducing LOGO to its primary classrooms in comparison with Walsall. Whilst some work on turtle graphics has been done in one or two schools working in isolation, no authority policy existed. The starting point of this work was quite simply to utilise someone else's development experience. Whatever the etiquette of this, the fact has to be faced that today's financial constraints dictate a sharing of resources and experience at a national level. So, with the precedent for cashing in on somebody else's ideas long ago established, work began in the summer of 1984 towards providing schools with a coherent policy towards introducing LOGO.

The first task was simply to talk to teachers who had been involved in LOGO primary schools. The Walsall Primary LOGO Project Team of Linda Spear and Julian Pixton gave me this initial insight. They outlined their philosophy as to why LOGO should be included in the primary curriculum and discussed their ideas of the progression and the classroom management and resources. The next step was to look at LOGO in action in the classroom; a couple of days spent in a Walsall junior school with a class teacher who had used LOGO for five months gave me this opportunity. As a result of the time spent in the West Midlands I felt I wanted to introduce their ideas into my own school.

The main progression I wanted to introduce is:

1. Introduce the children to the concept of a buggy obeying their commands using Big Trak. This is a toy currently available from most supermarkets and toy shops. It costs about £25.00.
2. Introduce the idea of the children planning their Big Trak sessions on paper with plenty of discussion among the group.
3. To move to the idea of writing procedures (i.e. the list of the moves of Big Trak), then testing and debugging these procedures until they worked as the children intended.
4. To progress to the floor turtle controlled by a micro-computer. Initially the more advanced Big Trak work is repeated at this stage.
5. To develop the full potential of turtle graphics with the screen turtle so that the groups of children are writing procedures using co-ordinates, passing variables and using recursion.
6. The introduction of full LOGO with multiple screen turtles and list processing.

A discussion of the classroom resources here will illustrate the debt owed to the Walsall group. Big Trak has already been mentioned; at the time of writing (December 1984) rumour has it that it is due to be discontinued. If so, it would be a great pity especially as the Walsall Team has produced an admirable teacher's resource book (see references). Whether an alternative could be found (for example using overlays on a Concept Keyboard powering a floor turtle) remains to be seen.

The Walsall team has also produced a Turtle Graphics chip which fits into one of the ROM sockets inside a B.B.C. computer. (This is an easy job for an l.e.a. technician.) and an accompanying teachers' resource book. The chip is designed to introduce both children and teachers to LOGO. It will run the corded Jessops Floor Turtle and the B.B.C. Buggy. Two other floor turtles are available – the Jessops remote turtle and the

Valiant remote turtle – which require routines to be written by the manufacturers if they are to be run from this chip. While it is a fairly powerful tool, much superior in my view to "DART" or "ARROW", it is not a full LOGO. It is easy to use and its syntax is easy to learn.

Once we arrive at a time when children have exhausted the potential of the chip, a full LOGO will be needed. At present this has not been identified. Several for the B.B.C. have been recently launched, but none has been reviewed fully. However the Walsall group is committed to the Atari LOGO. They suggest that because full LOGO is so time consuming, a LOGO dedicated machine could be the answer, in which case, it need not be a D.O.I. computer, since compatability is not a factor. Currently the offer for an Atari computer, tape recorder, LOGO cartridge and manuals is less than any of the full LOGOS for the B.B.C. computer.

Having established the overall strategy and identified the resources, it remained to put it all into practice. Consequently, I held a course for the staff of my own school and asked if teachers would be prepared to have a go themselves, following the philosophy of the two Walsall books. In September 1984 work on Big Trak was launched in all three infant classes and first and second year juniors. Progress is slow as the children work in groups of three at their own pace through the ideas presented in the "Big Trak Book". We aim to give each group two sessions of twenty minutes so that their own ideas may be fully explored.

Although the onslaught of Christmas has tended to interfere of late everyone seems happy with our work throughout the first term. The children have enjoyed their sessions and the pencil and paper planning sessions. When a complicated procedure works after a period of tracking down errors, their jubilation can be heard throughout the class. Other children are interested in watching the result, and ask "How did you do that?" and often the successful routine is modified to fit into their own procedures. Given the attitude of the teacher and the prop of Walsall's resource book, it really is quite easy to get work of this nature off the ground.

It was decided that one of the major contributions for computers in primary education in Bury for the 1984-85 year would be in LOGO. As a result, an introductory course of four evening sessions for beginners was arranged for each of the three terms. The first two are devoted to the teaching strategies of the Walsall team, the third to the syntax of the turtle graphics chip, and the final session is a discussion of the place of LOGO in the curriculum, the policy of individual schools and the problems of school and classroom management. Each participating school in the autumn term's course has been loaned a Big Trak for the term and has had their school's computer fitted with the Walsall turtle chip and been given the resource books.

There is no reason why Bury's primary schools should not be well on the way to LOGO by this time next year – that is, if they want to be. Certainly local authority support is there for teachers who wish to follow this road. All that is lacking is in-school support for those schools who are keen to give it a go. Again we return to the financial climate, and the scarcity of resources. As far as my own school is concerned, progress this year is limited to Big Trak but early next term I expect to see some of the groups in the two junior classes make the transition to the floor turtle. Once that happens, I think the momentum will increase.

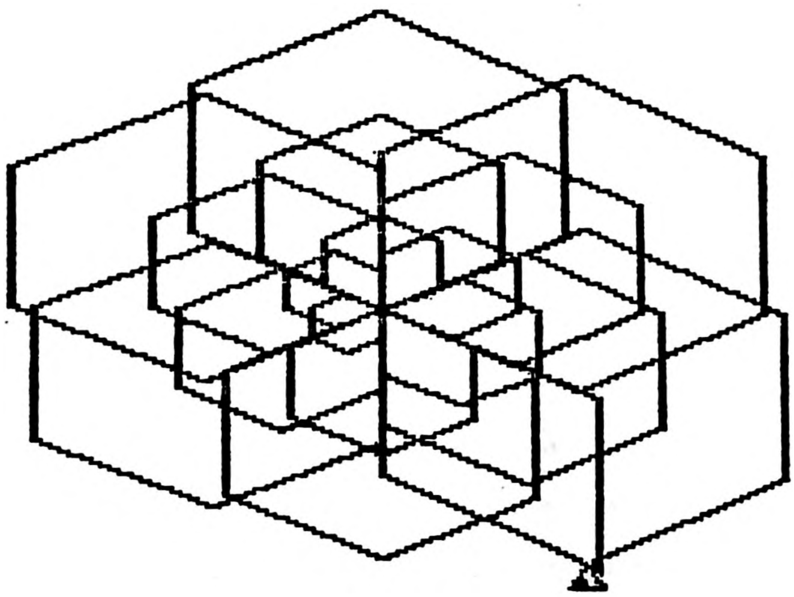
References.

1. "On the Right Track . . . With Big Trak" £5.00
2. The Turtle Graphics Eprom Chip is available free on receipt of a 2764-250nS EPROM.
3. "Talking Turtle" £5.00. This accompanies the turtle chip.

The above may be obtained from:

Walsall LOGO Project,
Busill Jones School,
Ashley Road,
Bloxwich, WS3 2QF.

Cheques should be made payable to "Walsall Metropolitan Borough (Walsall LOGO Project)".



Turtle Graphics: In-Service Training for Teachers by IC McNab and JI Brindle

Educational Psychologist, Tameside LEA; Headteacher, Tameside LEA

Introduction.
Teaching is addictive. Once we have learnt how to do it, we find it very difficult to stop. We spend a great deal of our time in the classroom communicating facts, explaining the steps in various tasks, making sure that children do things correctly and eliciting appropriate answers. Sometimes our teaching is done by asking leading questions and manoeuvring children in the right direction. The occasions on which we do not have a particular direction in mind are rare.

The situation is somewhat different in the home or in nursery or reception classes when parents and teachers are helping children to play constructively. This kind of teaching – if that is the proper word to use in this context – involves some special features not normally found elsewhere. The adult tends to offer possibilities to the child. He or she lets the child lead and participates in the child's activity by suggesting fruitful variations or making new materials available which the child can incorporate into his play if he wishes. The adult may demonstrate new ways of using the materials but rarely insists that the child should adopt them. This style of teaching depends a great deal on making creative use of the child's own activity to present wider opportunities which the child may or may not take up. Very young children cannot easily be made to relinquish control over their own learning!

It is this self-directed investigation and discovery, in which adults can be helpers but rarely instructors, which Seymour Papert – good Piagetian that he is – sees as the most powerful and personally significant form of learning. LOGO was designed to be a resource for this type of learning at a more advanced level. It provides, as it were, an intellectual version of sand-and-water play.

If LOGO is to be used in the manner for which it was designed, three things are necessary. Firstly, the way in which parents and teachers help very young children with the serious business of play has to be adopted with older learners. Secondly, those who are helping the learner to make use of LOGO need to have sufficient familiarity with it to be able to suggest interesting directions for development or offer new methods at the opportune moment. Thirdly, the adult has to remember what it is like to learn as a young child does. Only by recollecting the excitement and personal satisfaction which such learning entails will the methods and purposes of working with LOGO be evident.

Our in-service project grew out of a commitment not just to LOGO programming as an educational activity but to the attitude to the learner and to learning on which it is based. We wanted to help teachers to introduce turtle graphics to their schools in such a way that the educational philosophy which informed its invention should also inform classroom practice.

The project is outline.
We were in agreement with Papert's view that children should take control over their own learning. Certainly, we would have been (and are) appalled by the idea that children should be "taught how to program properly in LOGO". It would, therefore, have been contrary to our whole approach to turtle graphics to have set up an in-service training "course" for teachers in which they would be lectured on how to teach children to write turtle graphics programs. It seemed essential to avoid the situation portrayed in the old joke: "we've just sat through a two-hour lecture on the importance of active involvement in learning". In any case, we did not presume to be able to tell colleagues the "right" way to work with this new resource.

The in-service work consisted of seven sessions, each lasting one and a half hours. The first four sessions were practical workshops. The fifth comprised a discussion of the educational ideas underlying LOGO, for which everyone read Seymour Papert's book, "Mindstorms". The last two meetings were intended to allow teachers to plan the practicalities of introducing work with turtle graphics into their classrooms. In the event, one of these planning meetings was replaced by a further practical session. Follow-up meetings were arranged so that the participants in the project could provide continuing mutual support and help in solving practical problems which arose in using turtle graphics in the classroom.

The project in action.

When we started the project the nearest we could get to LOGO on the machines available in our LEA was the DART turtle graphics program. We therefore used this program for the workshops though we would have used the turtle graphics aspect of LOGO had we had proper Logo interpreters.

The workshops were central to the project. The general method we adopted in them was to enact, in a way appropriate to adults learners, activities resembling those which might be undertaken in the classroom. In essence, this entailed the participants using turtle graphics as a medium for inventing and solving their own problems with the support of the tutors. The main aim of the activity was to observe the process and experience of problem solving, in order to get a clearer understanding of what learners can gain from it, rather than to learn about turtle graphics programming. However, a good deal of learning was involved. Our own contributions, as tutors, in supporting this were also subjected to scrutiny.

Owing to constraints of time, some compromises were necessary in regard to our wish to simulate classroom methods. Thus, each practical session started with a short introduction to particular programming techniques relevant to the practical work. We also provided activity sheets containing suggestions for those who were initially uncertain of the sorts of investigation they might pursue. We would feel unhappy about using such methods with children because they do not take account of the needs and interests of individuals.

After the introduction, a typical practical session proceeded as follows. The twenty teachers formed groups of four. They took it in turns to work on problems at the computer in pairs while the other pair in the group observed. Participants were encouraged to work with different partners at each of the workshops. The tutors supported those working at the computers, in order to model ways of helping learners. The observers attended both to the activities, attitudes and methods of the learners and to the tutors' contributions. These practical/observation sessions were followed by discussions. For these, the teachers combined into two or three larger groups in which observations and experiences were reported back and examined.

Issues and reflections.

The central purpose of the Project was to focus attention on the experience of discovery learning and the role in it of teacher and peers. The following reflections illustrate some of the features noticed and some of the issues raised.

There were interesting similarities between the responses and feelings of the tutors and teachers in the project and those of teachers and children in the classroom. Most group members were understandably apprehensive. As one teacher put it,

> "I was petrified because I had never had contact with computers and expected everybody else to be whiz!"

For some, the group was a supportive feature:

> "I felt that I didn't want to make a fool of myself but, accepting that we were all in the same boat, [I was] prepared to give it a go. I knew that people would be sympathetic."

The apprehension was heightened by the awareness that those working on a problem would be watched by observers. In practice, the observing teachers found their task difficult. Everyone tended to become involved in the problem solving and observers continually joined in with suggestions. While this detracted to some extent from the observation, it gave a sharp awareness of the enormous restraint needed when working with children. Everyone saw that it is all too easy to take over someone else's activity.

The same issue arose in regard to working with a partner. The choice of partners was clearly an important factor in the success or otherwise of the activity from the individual's point of view:

> "I would have preferred not to be observed but it helped me to be able to work with somebody at the same stage as myself – for discussion – but if somebody was more knowledgeable then it was totally counterproductive."

One of the major factors in this dissatisfaction was that the learner was prevented from comprehending the task in his or her own way. One teacher expressed this very clearly, commenting that a more knowledgeable group member

> "kept pushing me and putting in stages that I wasn't ready for. This completely demoralised me and took away all my confidence. I think I would have been perfectly capable of working out the problem had I been able to work at my own speed."

It was clear that learners wanted to find things out for themselves. Contributions from the tutors were critical here. They could give too little or inappropriate advice:

> "Some inputs from the tutors didn't help as they assumed that I knew more than I did."

Just as easily, they could say too much:

> "Sometimes tutors told me too much. I remember one of them giving me the solution on one occasion which was OK at the time but I thought later that it was not the right thing to do."

The importance of being in control of one's own learning was repeatedly remarked on:

> "I felt really good when we solved something that I didn't think we'd be able to, especially as we had done it without any help."

Providing appropriate help to learners requires a good deal of self-awareness on the part of the teacher. Some assistance can give the learner confidence but it is all too easy to over-step the mark and take control away from the learner. The effect is that the learner feels dissatisfied and almost cheated:

> "Initially, I was almost paralysed with fear and afraid I was going to do something very silly. Later on, I felt a great sense of achievement when I managed to work something out. When the tutors helped me to sort something out there was not the same feeling of satisfaction as when *we* had worked it out and finished it with great whoops of joy!"

Certainly, the cheers of success following a completely unaided solution contrasted very noticeably with the lack of excitement when a group was given too much guidance by a tutor. It seemed that there was an intimate relationship between the joy experienced when a problem was successfully solved and the fact that the learners had made the problem their own – even if the idea had originally been suggested by a worksheet. The tutors therefore needed to be careful to respect the learners' own view of the problem. There was a continual danger of the tutors imposing their own conceptions and methods:

> "I would have preferred to have time to work on the problem myself, to complete it to my own satisfaction and, if necessary, ask for help when it was required. Some information was put in before I was ready. On at least one occasion the input by the tutor totally changed the problem we were working on, so we listened politely and then carried on working on our original problem!"

Would that all learners were so tenaciously self-respecting – and so polite!

The single most important feature of this type of learning will be evident from the above quotations. It is that it takes time. Allowing learners to proceed at their own pace can provoke anxiety in the teacher. The pressures of the curriculum and school organisation often militate against giving learners the time they need. All those involved in the project became acutely aware that one cannot safely force the pace of someone's learning:

> "... I would rather have been on my own with plenty of time to sort it out for myself ... Support was helpful initially but later one needed to work at one's own pace."

Working on one's own problem at one's own speed with appropriate help when it is needed has important effects on one's attitudes to mistakes. Errors seem more under one's own control:

> "You learn as much from your mistakes as from your successes."

We could not pass over this point without mentioning a spontaneous remark from a child in a junior school, which speaks worlds on the matter:

> "When you do maths with Miss [the child named his teacher] you can get them wrong but with the turtle there's always hope!"

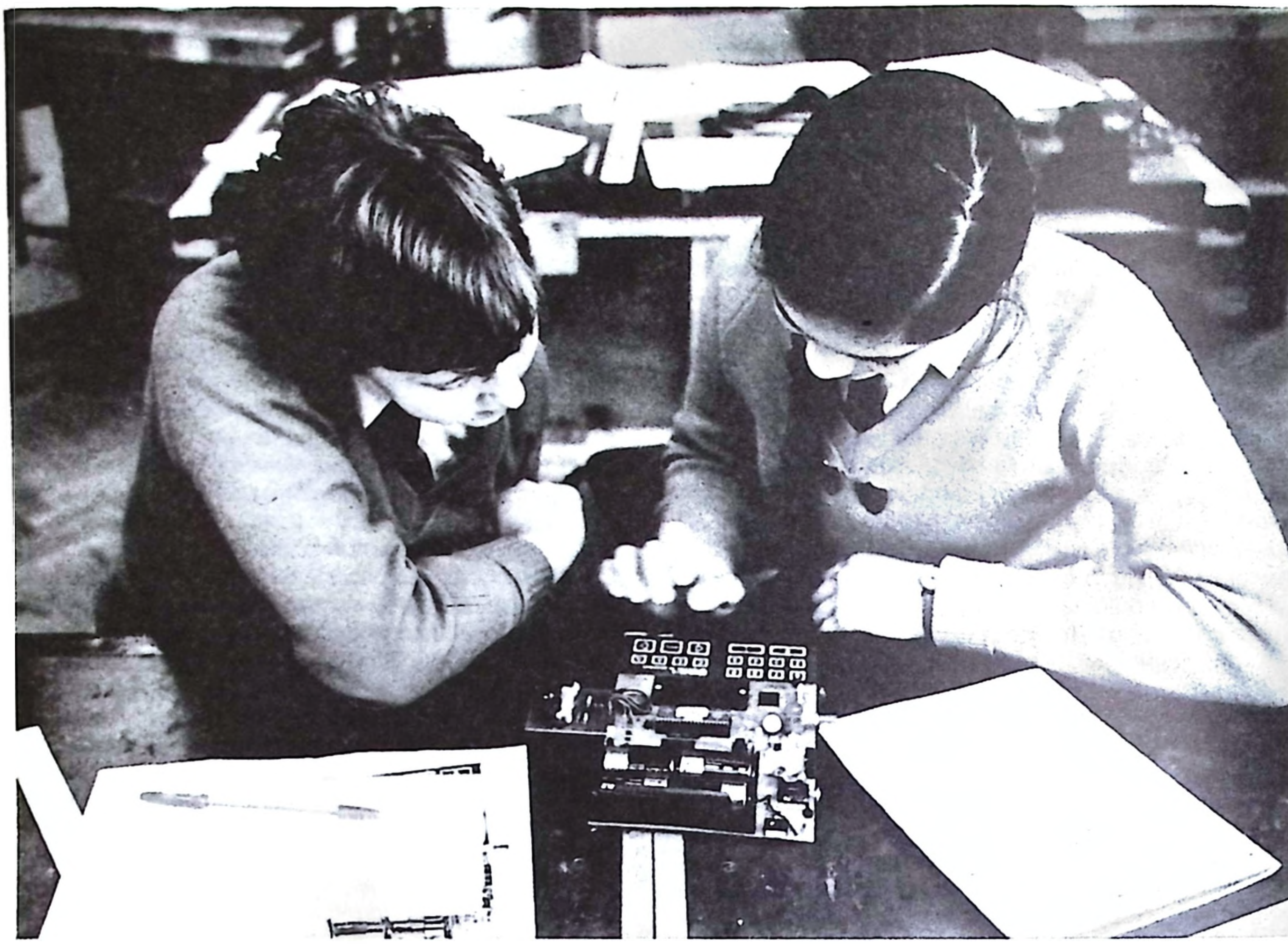
The need for time to accomodate new learning continues to be evident in the project. The first of the follow-up meetings was designed to introduce teachers to the delights of LCSI LOGO. This was an unmitigated failure. The teachers wanted to consolidate, not embark on a new and more complex venture. The next meeting will therefore start with short talks by two of the participants about their experiences of introducing turtle graphics to their pupils. The ensuing discussion will be followed by more "hands-on" experience with DART.

Conclusion

The project sought to address two important in-service training needs. Firstly if teachers are to have sufficient knowledge and confidence to help children to make use of turtle graphics, they need to be familiar with the programming techniques involved. In-service training clearly has to meet this basic need for information and practice.

The second matter is less easy to apprehend in an in-service course. To provide the right kind of support to children, we need to be aware of what is happening when they learn by investigating and solving problems. It may have been a long time since many of us were in a situation of learning by discovery. In-service work with turtle graphics provides an uncommon opportunity to experience the mental and emotional impact of such learning. If we are to appreciate what our pupils can gain from it, there is no substitute for carefully observed personal experience.

The project was designed to bring this experience into awareness as clearly as possible. The tutors and the participating teachers found the work enlightening, sometimes sobering but always compulsively engaging. We may not yet have overcome the addiction to teaching but let's hope that we are all learning to be "social teachers" – able to keep our habit under control!



Learning by doing: The Open University and computers in education by Helen Boyce

Micros in Schools Project, The Open University.

As part of the government's policy to provide a variety of ways for teachers to learn about the new microcomputers coming into their schools, the Open University Micros in Schools Project was started three years ago with a grant from the Microelectronics Education Programme.

We designed a programme of study packs that would:

- cover the main application of micros,
- enable teachers to make informed decisions on the use of micros in the schools,
- provide the practical skills needed for teachers to exploit the new technology in the curriculum.

From these broad aims five packs were developed and, where appropriate, different versions were made so that all the main school micros would be catered for: BBC, RML 380Z, RML 480Z, Spectrum and Apple II.

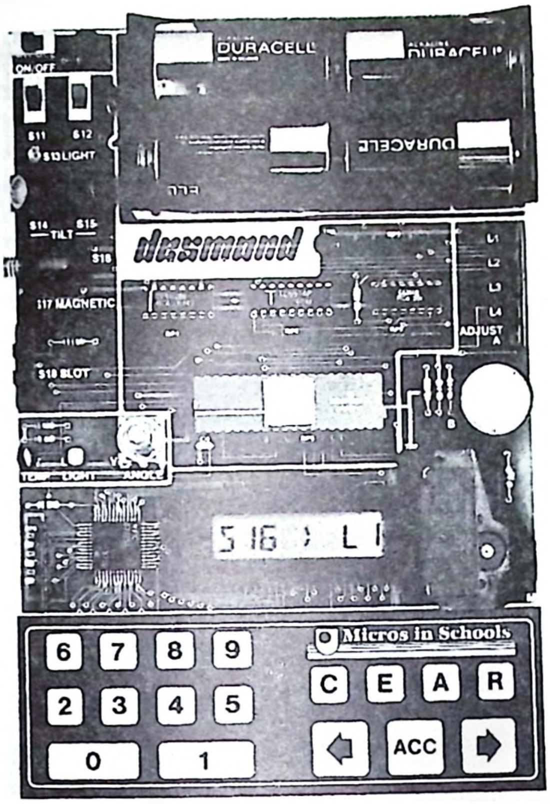
A basic awareness pack is written in versions for all these computers. This course is designed for the complete beginner so that he or she may sit with the computer and learn from scratch how to link up the leads from machine to monitor etc; how to switch on the different items; how to load and run software (provided in the pack). The software is chosen so as to illustrate the main educational applications of computers: information retrieval, electronic blackboard, calculation, simulation and game playing. (Simple word processing is covered in a later pack – Micros in action in the classroom).

Learning about microelectronics

DESMOND is a self-contained microcomputer designed to make microelectronics easy to learn. In addition to electronic building-block circuits, it contains sensors for light, tilt, position and magnetism, some switches, several lamps, a buzzer, a small motor, and an 8 character display. The components are connected electronically, by using a small keyboard. There is no soldering as there are no wires to be joined, thus eliminating one of the main causes of difficulty with kits.

This makes it easy for you to understand the design and logic of electronic circuits without at the same time having to master constructional skills as well. Because all the devices are firmly attached to the computer, damage to and loss of expensive components is greatly reduced.

In reality DESMOND is two microcomputers in one. With a single key press you can change it from a circuit



design-simulator into a computer programmable directly in a simple machine/assembly code, and use these programs to control the various sensing devices on DESMOND. DESMOND can be slipped easily into a briefcase for carrying between school and home, and requires no screen or mains power for its use. What you must have is access to one or both of the practical books (described below) that take you through all the facets of DESMOND's dual personality.

Interested in Learning about Microelectronics?

Based upon 'learning by doing' the Learning about Microelectronics pack, together with DESMOND, takes the complete beginner systematically through a carefully structured introduction to the basic principles of microelectronics. A highly detailed step-by-step practical book shows you how to design circuits using DESMOND's sensors and other devices. For instance, you can build a digital spirit-level or a light-sensitive burglar alarm. The pack also includes a beautifully designed, full-colour booklet providing essential background information, useful both to you and, later, to many of your pupils.

Practical advice on teaching microelectronics and a supporting range of case studies provide ideas on how you can lead children and students into learning about these topics. This pack represents a very valuable resource, for any teachers who want to discover more about microelectronics for themselves, and to help their children to do likewise.

Inside microcomputers

It is a daunting task for the beginner to understand micros such as the BBC or RML machines, because they are designed to perform a multiplicity of complex tasks, many requiring that you have special additional equipment or software. The fundamental structure of the microcomputer and how it performs its work is difficult to grasp if you start with such complex and expensive examples. It is not a coincidence that DESMOND is designed so that all its components and circuits are easily visible to you when used with the pack 'Inside Microcomputers', DESMOND functions as a 'simple' but effective microcomputer, the study of which provides a stepping stone to understanding the workings of its larger relatives.

The accompanying pack gives information about how a micro functions and provides practical help with teaching about it. It is intended for those who teach in the 8 – 16 age range. It aims to provide familiarity for the beginner, through a series of activities using DESMOND. You learn to program the sensing and controlling devices on DESMOND in simple machine/assembly code. There is a full colour book covering the development and application of microcomputers, a practical book giving a graded set of activities for use with DESMOND and a case study book. In the 30 minute video cassette, we follow the progress in learning about micros and control of a group of twelve-year olds in a Bedfordshire Middle School. Their teacher planned a term's work using sets of the DESMOND microcomputer.

An essential part of the development of the DESMOND packs (as with all the Project's materials) was field testing by teachers in their own classrooms. The Project team had thought originally of DESMOND (see picture) only as a device for helping teachers themselves to learn through guided activity, but some of the teacher developers had other ideas, getting double value from DESMOND by using it also as an inexpensive and portable classroom device for use by their children or students.

Computer assisted learning

Integrating the microcomputer into classroom activities creates entirely novel problems of organisation and planning. 'Microcomputers in Action in the Classroom' sets out to show you how some 30 teachers have responded to this challenge, what problems they found and how they overcame them. All the case studies are written by the teachers themselves, while the study guide provided helps you to analyse their experience and its relevance to your own classroom planning. At the suggestion of a number of teacher colleagues who helped us design the pack, several case studies are included that cover the problems of introducing microcomputers at the departmental and school levels.

The pack also includes audio and video cassettes and a set of programs (including TRAY, QUEST and a simple word processing program for infant use) most of which feature in the case studies. The pack provides step-by-step guidance on using these programs, but also suggests classroom-based activities for you to try out and evaluate.

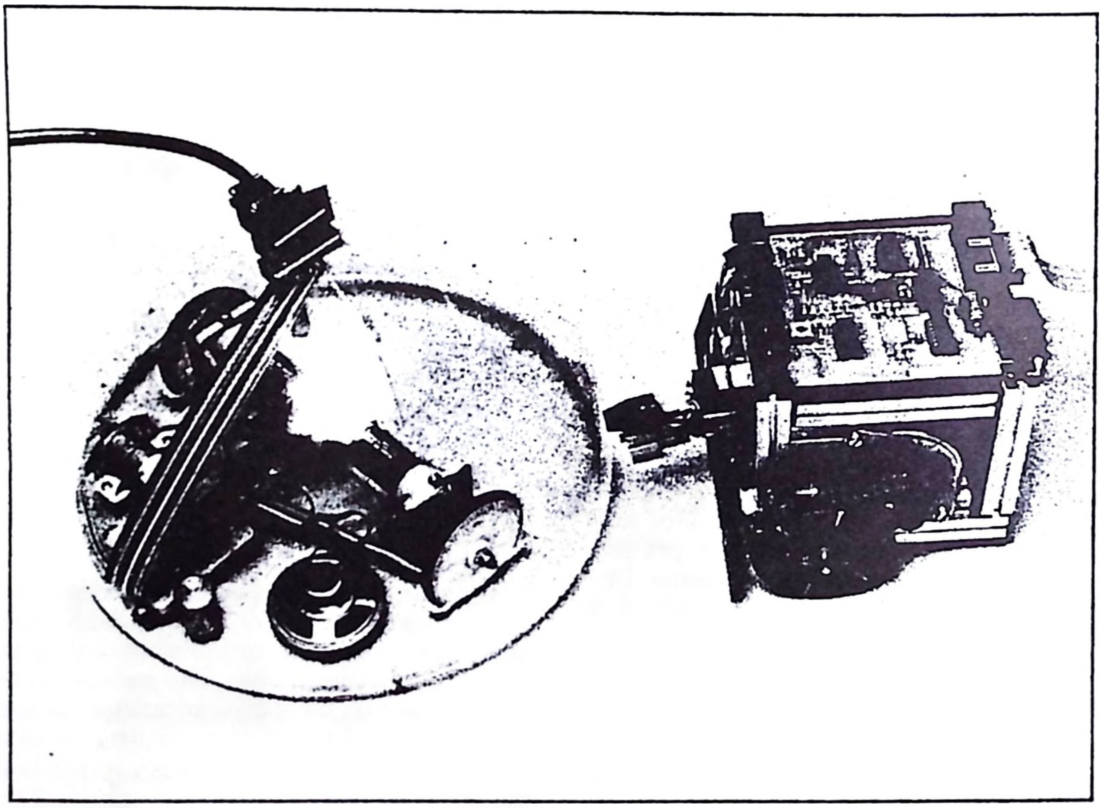
As with 'Educational Software', a full Logo implementation is included with the pack for the currently available BBC and RML versions. The BBC version of the pack uses Open Logo, which has been designed specifically for the Project by the Open University's own Academic Computing Service. This provides the school with a very sophisticated additional computer language, easily fitted alongside BASIC in your computer. As with the programs provided, the use of Logo (including your own) is dealt with systematically through the case studies, activity book and study guide. A full user's manual for Open Logo will be provided free either with the pack or when available, enabling you to extend the use of your Open Logo far beyond uses dealt with in the pack itself. This arguably makes the BBC versions of this pack and 'Educational Software' amongst the best value of any packages available for schools and colleges using BBC machines.

Educational software – how do you choose?
One response to the poor quality of commercial educational software is (quite rightly) to press for better to be written – but even when it is, how are you to choose the gold from the dross? 'Educational Software' is a pack for teachers who already have some confidence in the use of microcomputers in the classroom, but wish to learn how to evaluate and to some extent modify available educational software. Example programs, an audio-cassette and a video-cassette, a carefully designed activity book and study guide are all included. The BBC, RML 380Z and LINK 480z versions of the packs also include a full implementation of LOGO. The construction of simple programs in Logo is included as part of the work in the activity book, giving you a chance to see for yourself how it compares with BASIC. We expect this pack to be particularly useful to heads or teachers choosing software for their schools, and to teacher students in initial training who hope to use micros in their classrooms.

Getting colleagues started on micros?
Over 2500 of the Project's low-cost Awareness packs have now been sold, suggesting that nearly one school in ten has used the pack to help it get started on micros. For heads or teachers with responsibility for computers across the curriculum the pack provides a very flexible resource for assisting colleagues new to, and perhaps apprehensive about, computers. It starts absolutely from scratch, explaining how to set up the computer (with special Spectrum, BBC, 380Z 480Z and Apple versions of the text) and showing precisely what will appear on the screen as the teacher works through the activities. Like all the Project's packs, it can be used for individual private study, at school or home, or as a resource for school-based staff development in a group situation. We start to explain how to evaluate educational software, and the classroom case studies and programs included provide plenty to think about for the beginner, and scope for group discussion.

If you would like to be on the mailing list for Micros in Schools, please send your name and address to:

The Project Manager (PTM)
Micros in Schools
Open University
Walton Hall
Milton Keynes, MK7 6AA



Teaching Teachers about Control Technology

by Reg Eyre

College of St. Paul and St. Mary, Cheltenham.

Lecturers at the College of St Paul and St Mary, Cheltenham, have been running courses for teachers which contain components on the use of control technology and computers. These courses appeared to be successful, in that the teachers enjoyed making 'Buggies', 'Conveyor Belts', 'Temperature/Light/Sound probes' etc. However, there was always a feeling on our part that few of these ideas were subsequently being put into practice in the schools.

The majority of these courses had been for Secondary Science and Technology teachers. Primary school teachers on all of our courses were shown this type of work, and invited to try the ideas with their classes. The majority of these teachers felt that either they or the children could not cope, and, ". . . anyway, this work is not possible with 30 children, no equipment, and only one computer!"

I feel that I have shown that this type of work is possible, having had the opportunity to work with classes of junior and secondary pupils under various conditions (see earlier article). I only have to show examples of the 'Buggies' which children have made and their own video recordings in which they explain how they made their 'Buggies' and the problems encountered in the process, for teachers to get enthused and want to go back to their classrooms to do the same work.

The dilemma for me is that if I show teachers what I've done with children, they want to go back to their own school and replicate exactly what I did. What I want them to do is take up the ideas and adapt them for use in their own classroom practice. The major worry I have is that teachers will adopt a 'Blue Peter' approach to this type of work, whereas I want them to be more open-ended and willing to let the pupils try out ideas for themselves.

The approach I am currently adopting is to show the teachers the video recordings and 'Buggies' made by the pupils, and then set them different problems so that they cannot copy what they have just seen. Examples of this are:–

(i) Make a buggy capable of 'walking' on water
(ii) Make a buggy which will 'walk' upstairs
(iii) Make a motorised musical instrument.

The delight even adults display when they have succeeded in overcoming a multitude of problems, seeing, for example, their own buggy walking across a pond, is an experience I shall not forget easily.

These problems are not for the children to solve (or are they?) but to expose the teachers to the consultative approach I would like them to adopt towards their pupils' problem-solving activities.

The major problem we have yet to solve is the use of the computer as a switch. Our current thinking is to use the printer port to control the buggies, and use the 'user' port to accept 'input-information' such as bump switches from the buggy, thus enabling us to talk about open and closed systems.

So far we have used both pupil and teacher worksheets. We hope to forget about these soon and start using LOGO as the natural language to control mechanisms external to the computer.

Introducing Logic as a Computer Language into the Classroom by Richard Ennals

Department of Computing, Imperial College.

Logic is of itself neutral regarding subject content, but offers a form in which a great variety of descriptions and arguments can be expressed. Similarly, information technology and in particular computers, offers powerful tools which can be deployed for numerous different purposes. Logic programming, combining the benefits of both the logical form of description for the user, and the power of the computer which takes such descriptions as programs for solving problems, is also open to a great range of uses. This is true not only in the field of advanced research, where logic programming is used for databases, expert systems, natural language understanding, specification and software engineering, as well as providing the foundations for the new Fifth Generation of Computers currently under development in Japan and elsewhere: it is equally true in education, where we are teaching the future users of Fifth Generation Computers, and future participating members of human society.

micro-PROLOG was implemented in 1980 to provide a microcomputer version of PROLOG to support the "Logic as a Computer Language for Children" project, based at Imperial College.

There have been implementations of PROLOG since Roussel's first version in 1972, developed in Alain Colmerauer's research group in Marseilles. There are now few computers of whatever size for which at least one version is not available, and despite differences in surface syntax and the sophistication of the programming environment offered, the underlying logic is the same, simple but powerful.

For classroom purposes micro-PROLOG needed to be robust, compact and accessible to children. Not only should it be available for standard school microcomputers, such as those based on the Z80 and 6502 microprocessors, but the syntax and notation should not be such as to stand in the way of easy use by children for describing and solving the problems of their choice. Different educational users of micro-PROLOG have had different objectives in the classroom in the pursuit of which they have used micro-PROLOG as a tool.

The Micro-Prolog Project

The "Logic as a Computer Language for Children" project has been concerned as far as possible, with the use of logic to help in thinking, as opposed to emphasizing PROLOG as a programming language for children. Our approach has been declarative, describing problems, and producing specifications which can be taken by the computer as programs and executed. We have not given attention to the computer as such, and considerations of efficiency have not been seen as the concern of the user, though an increasingly intelligent system can detect loops or even reorder queries to facilitate speedy answers.

Our initial classroom approach, with a class of thirty ten-year-olds, was through database querying, based on the idea that the citizen's typical contact with a computer would be as someone needing information. Using the "simple" front-end program, itself written in micro-

PROLOG as a module, questions could be asked, either expecting a YES/NO answer, as in the case of

is (Reagan president-of USA)

or seeking a particular piece of information

which (x: x prime-minister-of UK)
Thatcher
No (more) answers

In both cases the answer will depend on the information given (and when it was given). A student could easily add to the database

add (Mitterand president-of France)

and thus move without difficulty from database querying to simple programming.

Having asked simple questions, the students moved on to complex questions to unseen databases. A sufficiently interesting example could motivate a flow of complex queries. The most successful example, both at the original pilot school where it was written with the students, and internationally, has been the murder mystery. The body of Susie has been found, and the detectives interrogate the database of known information. Further information has to be added before they are able to arrive at a firm conclusion.

Teachers of History and of English have taken the above idea to develop larger databases of historical information, for regarding primary historical sources as databases (using such sources as census records and trade directories) and for motivating students in creative writing.

Some users have found micro-PROLOG difficult to learn, and have sought simplification for their students. Nichol and Dean in particular wanted a more "subject oriented" approach to queries, and they wanted to be able to represent pages of text. Accordingly a "tell-about" command was written. Using their detective database about the body of "Grauballe Man" an archaeological problem they could ask

tell-about body
answer is found in the peat bogs of Northern Denmark was that of a man, naked, with a noose tied round the neck
no (more) information

A History example

A variety of different "front-end" programs can be used with PROLOG, depending on the needs of the user. In the next example a history class is exploring concepts of revolution, based on their study of revolutions in France, America, the Soviet Union and China. They have tried to describe relevant structures, such as the class system and the routes between the classes

aristocracy to royalty
bourgeoisie to aristocracy
proletariat to bourgeoisie
peasantry to bourgeoisie
peasantry to proletariat

and they say that individuals can travel either way

x linked-to y if x to y
x linked-to y if y to x

Social class can be defined in terms of occupation

x class y if x job z and z classed-as y

and some example job classifications can be given

x classed-as royalty if x ON (king queen prince)
x classed-as proletariat if x ON (steelworker factory-worker miner soldier sailor shopworker)

A similar account can be given of the spectrum of party politics

socialist near communist
social-democrat near socialist
etc

We can go further and develop, using Jonathan Briggs' "PLAN" program, our own little revolutionary adventure game, built up out of our description of a given historical situation. Alternatively we can develop an "ideal type" situation with which particular cases can be contrasted.

As story writer I must describe various aspects of the world of the story. I identify various places through which my character may pass, such as isolation, small-group, large-group, parliament, control. Note that the places do not have to be physical or geographical, but can be conceptual, concerning parts of the structure of the problem domain. I can describe various objects as being found in different places, such as poverty in isolation, administrative support in the large group. I can describe exits between the different places in given directions, such as from small group to large group towards power. Fuller descriptions can be given, such as of revolutionary principles as "Marxist and Populist views", and of Parliament as "an assembly of dubiously elected members". My initial location is isolation. What follows is a sample use of the story framework just described:

You are standing in an area devoid of power and privilege
You can exit:–
quick-route-to-power
towards-power
As you look around, you see:–
Marxist and Populist views and poverty
You are not carrying anthing
>> take poverty and move towards-power.

When such programs are used in the classroom the students can either make a move or stop and add further details, for example

>> stop.
add object
There follows a prompt by the system
(location object)
and the user types, for example
(isolation unemployment)
and then resumes by typing
>> go.

A novel use of Prolog

Another novel use of PROLOG involves collaborative problem-solving, where the student and the computer together must try to resolve a problem that is too complex for either alone. My example here concerns the nuclear arms race, and approaches by East and West to peace talks. We can build a simple model of the negotiations as a first approximation:

arms-race outcome if USA decides arm and USSR decides arm
peace-talks outcome if USA decides stop and USSR decides stop
(x lead)outcome if x decides arm and y decides stop

What, then is the outcome? It is up to the users, and the system will "query the user" when it needs information:
We start with our question

which (x: x outcome)

and the system replies

which (x: x decides arm)?

and we can decide how to reply, for example

answer is USA

answer is end
the system then asks
which (x: x decides stop)?
and we could reply
answer is USSR
answer is end
It would then provide the answer
==> (USA lead)
No (more) answers

In an expanded account we might want, for instance, to allow three alternative responses of arm, freeze or disarm. We might want to include some measurement of the relative strengths of the two sides, and some account of public and private negotiating strategies based on trust or distrust between the parties. It is up to us to develop the model in the first instance, and to modify it to suit our requirements, in the light of responses from "negotiators" or "users".

There are many areas in which the subject matter of "expert systems", increasingly written in PROLOG, can be made available to the student or ordinary citizen. The same logic that enables the system to reach its conclusions provides the means of explaining those decisions. A system that is concerned with translating between natural languages could provide an explanation in terms of grammatical rules. A system concerned with medical diagnosis can provide practice for students without endangering live patients. With growing memory capacity of microcomputers it becomes more feasible to talk of natural language communication with computers, rendering knowledge by the user of a particular computer language unnecessary. Experts still have to be prepared to explain themselves, both to students and to computers. The citizen will need to think clearly, but not in terms of machines.

Toolkits for Micro-PROLOG by Jacqueline Dean

School of Education, University of Exeter.

Micro-PROLOG is a superbly clear, descriptive, logic-based programming language, particularly suitable for use in the Humanities area of the curriculum. In order to make it easier and more comprehensible for naive users, various front-end "toolkit" programs have been developed. These toolkits have been created by Logic Programming Associates (LPA), Imperial College and the Exeter Project (see Appendix). The most recent toolkits (i.e. DETECT, UTIL, SIMPLAY) have been written by Jonathan Briggs specifically for education. They enable teachers or pupils without programming skills to write their own micro-PROLOG programs.

The Exeter Project aims to produce a comprehensive set of toolkit programs for use by non-expert-programmer teachers and pupils across the curriculum. Initially the toolkits have been developed for the Humanities, as this is the Project's present area of expertise. The Project's toolkits are designed to free teachers from the "stultifying activities which supposedly go under the name of . . . software" (Avon History Teacher, November, 1984) and enable ". . . teacher and pupils to create their own educational software as and when seems appropriate, thus freeing them from the commercial program writers who may regard "education" as simply another market place for their wares" (Computer Science Teacher, September, 1984). These teachers were commenting favourably on micro-PROLOG toolkits they had encountered.

Major micro-PROLOG toolkits:

Large, comprehensive programs designed to teach programming in logic	MICRO SIMPLE MITSI
Interactive, query-the-user program	CHIMP
Compact, specific-purpose "enabling" programs	PLAN SIMPLAY DETECT FACTLOG
Small, general-purpose convenience program	UTIL

A brief description of the newer toolkits:
(The others have been documented elsewhere).

1. **MITSI** (Man In The Street Interface)
This program introduces novices to many of micro-PROLOG's functions and capabilities, and does so without using intimidating code, or even variables like x, y or z. It puts the pupil programmer at ease because it is close to natural English, although of course certain forms do have to be observed. MITSI introduces database construction and querying, the writing of rules which can be applied to the database, and simple list-making and list-processing. To add facts, any number of which form a database, one can enter, say,

    Edward8 was king.
    Edward8 married Mrs-Simpson.
    Mrs-Simpson was-a divorcee.

The structure is in fact the same as that of SIMPLE micro-PROLOG, without the brackets and command words.
A rule which can be applied to this little database is:

    someone forced-to abdicate if
    someone was king and
    someone married somewoman and
    somewoman was-a divorcee.

One queries the database by asking, for example,

    someone married Mrs-Simpson?
    or
    someone forced-to abdicate?

MITSI will answer:

    YES Edward8 married Mrs-Simpson
    or
    YES Edward8 forced-to abdicate

Lists are easily constructed, and simple list-processing can be done, for example:

Queens-children are (Charles Anne Andrew Edward).
someone is princess if
someone belongs-to (Margaret Anne Diana Alexandra).

2. **PLAN** (Programming Language for Adventuring Novices)
PLAN, as its name suggests, enables novices to write their own adventure games. It allows them to create locations, to add exits or "doors" between these locations, to place objects or people in the locations, to create actions and to specify the results of these actions.
PLAN includes three separate environments:
a) That of the actual adventure game in which the player moves.
b) A programming mode, which allows the user to create the physical world of his game by describing it to the computer, using the categories: location, exit, object, action, description, with the command word *add*. For example,

```
add object
```

PLAN responds with a prompt which displays the formula for entering the object, i.e.

```
place object) ?
```

The programmer thus answers, say,

```
(room3 pistol)
```

naming the place and the object as requested.
c) micro-PROLOG's internal syntax, which the programmer uses to define actions and their results. PLAN does have several built-in actions (move, take, drop, help). However, an adventure using only these action words does not have much flexibility. Therefore PLAN allows the creation of new actions, using internal syntax and variables. As before, a prompt displaying the correct entry pattern is displayed. The programmer types:

```
add action
```

PLAN replies:

```
((user types)(conditions)(results)) ?
```

i.e. first give what the user of the game must type in, then the conditions which must be met in order for the action to take place, then specify the results of such action. The programmer can now enter, say:

```
(kill x)(WITH x HAVE y weapon y)
(REMOVE x PRINT ( x lies dead on the floor)))
```

i.e. in order for his command to kill someone (x) to be carried out, the adventurer must meet these conditions: he must be in the same location as x (WITH x), and he must HAVE in his possession a y, such y having previously been defined as a weapon. If these conditions are met PLAN will produce the result by REMOVE-ing x from the game and PRINTing the final message on the screen, inserting the name of the dead person in place of the x.
Despite its apparent complexity, pupils of all ages master PLAN easily. Its well-defined categories of information and the templates it provides for users ensure this.

3. **CHIMP** (Children's Interactive micro-PROLOG)
CHIMP uses the same syntax as SIMPLE, and is distinguished from it mainly by its query-the-user facility. (For how to use SIMPLE micro-PROLOG, see: Clark, Ennals & McCabe, 1981, and Ennals, 1982).
With CHIMP, unlike other micro-PROLOG toolkits, one does not begin by describing "a state of the world", by constructing a database. One has to start by entering rules. These rules enable CHIMP to ask the user questions, the answers to which form a database of facts – so CHIMP constructs its own database.

4. **UTIL**
This is a tiny convenience program. It is best used in conjunction with one of the compact specific-purpose front-ends. It allows programmers to:
a) *edit* their data. The UTIL editor is the same as the SIMPLE editor.
b) *list* their program, or part thereof. Sentences in the database are numbered for easy recall (for alteration or deletion).
c) *delete* any clause for a specified relationship.
d) *kill* any relationship.
UTIL also contains an error handler which provides appropriate error messages. It thus supplies many of SIMPLE's facilities, while using but a fraction of the memory space taken up by SIMPLE.

5. **DETECT**
This program allows naive programmers to write large databases for exploration by users. These databases essentially contain information which "detective" users must extract in order to solve a mystery.
DETECT provides:
a) Five user query words, viz: 1. tell-about
2. interview
3. read
4. search
5. dig
b) Five relationships (predicates) to cover the five possible categories of information the programmer might use. These are linked to the five query words. The five matching categories of information are: 1. *facts* about people or things; 2. what people *said*; 3. relevant *written* documents; 4. what a physical *search* would uncover; 5. what is *contained* in an area dug up (this is designed for archaeological excavations).
c) Facilities for attractive display of text.

6. **SIMPLAY** (Simulations In micro-PROLOG for Laymen)
This program provides a blueprint for writing simulations.
Each programmer inserts his/her own structure and data.
SIMPLAY supplies:
a) Four categories of information which can be entered, using the command word *add*: start, link, choice, text.
For example,

```
add choice
```

As with PLAN, SIMPLAY responds with a template for the programmer to copy when entering his/her data.

text enables the programmer to insert text of his/her choice;

start allows him/her to specify a starting point for the simulation;

link allows definition of the links between events;

choice enables him/her to define the number and type of choices to be presented to the user, and which results follow these choices.

b) Improved screen display, including the screen being cleared before each user input. This represents an advance for micro-PROLOG, which has been – rightly – criticised for its poor visual display.

c) Ease of use for users, of the "Press any key to continue" variety.

Other compact toolkits the Exeter Project plans to develop during the coming year include one for creating graphics, one for taxonomies and one for trading networks.

These toolkits will be particularly useful in schools because:

a) They allow pupils to create their own programs, i.e. successfully control their own learning without having to master complex programming code.

b) The programs pupils can create are not restricted to the trivial.

c) They introduce children to logic programming, which is essentially the art of clear description and straight thinking. These are highly desirable skills across the curriculum and for life.

d) These skills are being acquired in a palatable and motivating environment.

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NOTE: micro-PROLOG is currently available on RML 380Z and 480Z machines, AppleII, Sinclair Spectrum, and Z80 based micros. Acorn has promised that the micro-PROLOG chip for the BBC will be available by Easter 1985.

Appendix

The Exeter Project

This Nuffield-funded project is currently investigating the use of micro-PROLOG in History teaching, and also as a programming language across the curriculum. The project has a particular interest in the implications of computer use for children's thinking, mental modelling, learning theory and in the construction of man-machine interfaces and expert systems.

The project team comprises:

Jon Nichol (Director)	School of Edcation, Exeter University.
Jonathan Briggs	Logic Programming Associates.
Derek Brough	Imperial College, London
Jacqueline Dean	School of Education, Exeter University
Chris Tompsett	Kingston College of Further Education.

'Monitoring and Assessing Children's Conceptual Development'

– (A report of an M.E.P. Project based at Pentland Primary School – Cleveland)

by Anne Liddle

Headteacher, Pentland Primary School.

The two year project began on October 1st, 1982, and its theme is the exploration of Computer Managed Learning in the Primary School. Interest in this area evolved shortly after 1979 when we first began to use computers in our school. As a variety of management strategies for C.A.L. began to develop, curiosity about the role of the computer in general teaching management began to emerge. Through our observations we felt that Computer Managed Learning could feature quite significantly in the Primary School. Although at the moment the majority of schools have access to only one computer, this situation is rapidly changing. In the future it is expected that computers will be commonplace in people's lives at work and at home. It is quite feasible to expect that teachers will have computers at their disposal to support them in the management as well as the provision of children's learning experiences.

The computer can collect, store, calculate and present information with ease, and all these aspects have obvious potential for school management. However, we wanted to determine ways in which the computer could be used particularly in classroom management to support the practising teacher.

Most teachers admit that one of their most demanding classroom tasks each day, is gathering the required amount of pertinent information about the children in their care in order to check and plan their progress.

'The structure of the subject matter is one of the most important influences on the work schools do, but as every teacher knows, it would be pointless to follow that structure without regard to the pupils' understanding and ability to respond. The pupils' stages of development and their individual capacities and difficulties are the most important element in a school's work. To be able to assess this development, and to present each child with work of the right level of difficulty, are two of a teacher's most valuable skills' – School's Council Working Paper '76 'Primary Practice'.

The day to day assessment procedures adopted by the majority of teachers lean heavily upon observational and discussion techniques. Realistically, in a busy classroom with the varied amount of curriculum aspects to be pursued, the practical impositions of the school, and the number of children needing attention, teachers find it extremely difficult to go beyond establishing a basic level of success or failure in children's daily work. Ideally assessment should take into account the quality, level and totality of success and indicate the directions of failure; it ought to have a diagnostic function concerned with different skills, abilities and attitudes.

Many of the computer programs used in schools contain elements to collect and present scores and times etc. There are more demanding programs which challenge children with problems and pose questions, which expose their knowledge of skills and concepts from which a skilled teacher can gain information regarding the children's understandings and relative progress. It was felt that by using a combination of these elements the computer could provide valuable support for the teacher in their day to day assessment procedures.

Programs to support assessment

The project's initial objective was to develop a series of programs to support the teacher in monitoring and assessing children's progress in key curriculum areas. The emphasis was to be on children's ideas and interpretations in relation to certain selected concepts and *not* on the acquisition of facts. Each set of project programs have been based on key learning stages within certain chosen concepts. It is essential to see the programs as only part of an overall learning framework and to put them in the context of the whole presentation of each specific concept.

The selection of concepts to be used was very difficult to make. We felt that if the programs were really going to be of value, then they should help us with concepts which we found challenging to assess. Like many schools we could readily relate to the following remarks.

"The increasing use of approaches to mathematics which are based on practical experience has led to a wideness of the mathematics curriculum – However, work of this kind needs to be carefully structured with due regard to planning and continuity, to methods of assessment and recording, and to consistency in the development of work in the school as a whole so as to ensure progression" – Cockcroft.

"It is all too easy to restrict assessment to those aspects of Mathematics teaching which are most easily tested. Efforts should be made to broaden assessment procedures to include as many as possible of the initially planned objectives of the course" – Math. 5 – 11

The first sets of programs

The first three sets of programs developed were based on the concepts Area, Weight and Volume. One of our main problems with the project was the amount of research needed to design and develop the programs, with only a part time teacher and programmer as project staff time was very precious. The three particular concepts were chosen because in school we had some materials produced by a School's Council Project "Area, Weight and Volume; monitoring and encouraging children's conceptual development". Although this material was very good, the advocated assessment procedures were difficult to administer, very time consuming and impossible to conduct in a busy classroom. Teachers had enormous difficulty in refraining from asking leading questions, in prompting and maintaining a fair and consistent assessment presentation. Nevertheless, the material was ideal as a basis for our project.

The many people who have been involved with research projects will sympathise when I say that the project leapt from one problem to another. The difficulties were too many to mention in detail in this short report. They ranged from design problems in trying to keep instructions readable and simple, lack of computer memory size, the elimination of the break key position so results were not erased, complex decisions regarding the diagnostic results to be obtained and the process of establishing constructive program evaluation.

The programs produced in the mathematical packages are as follows:-

M.E.P. Project
'Monitoring and Assessing Children's Conceptual Development'
<u>PACKAGE OUTLINE – WEIGHT</u>

Program 1 'TERMAP'
The children are asked to compare objects of similar volume by direct handling, using the terminology 'heavier' and 'lighter'.
Program 2 'TM/BAL'
The children are shown objects on a screen balance and are asked to make statements regarding their observations.
Program 3 'EXTERMS'
The children are asked to compare objects of similar volume by direct handling, using extended terminology eg 'weighs more', weighs less' 'equal to' 'same as'
Program 4 'BAL/PRN'
The children are given the weight relationships of objects and using the information they have to predict the movement of an equal arm balance.
Program 5 'CONSERV'
The children are involved with two activities dealing with discontinuous conservation.
Program 6 'UNITS'
The children are asked to compare the weights of objects using units. The children have to deal with the weight relationships first using arbitrary units and then standard units.
Program 7 'DIF/VOL'
The children are asked to find the weights of objects of different volumes. The children are then asked questions related to the ordering of the objects.
Program 8 'ORD/WTS'
The children have to solve a problem using observations and logical reasoning.
Program 9 'Logic'
The children are given problems where they have to obtain and store information and then order the information to arrive at logical answers.

M.E.P. Project
'Monitoring and Assessing Children's Conceptual Development'
<u>PACKAGE OUTLINE – VOLUME</u>

Program 1 'MATCH 1'
Matching objects of similar volumes
The children have to match cuboids showing and understanding of the relevant terminology and an awareness of the dimensions of the cuboids.
Program 2 'MATCH 2'
The children have to match blocks which have to be either turned onto different faces or mentally cut and halved to be matched.
Program 3 'Conserx'
The children have to deal with conservation activities in relation to external volume (using cuboids)
Program 4 'Conserc'
The children have to deal with conservation activities in

relation to internal volume (capacity)
Both conservation programs 3 and 4 help to distinguish children who base conclusions on perceptual observations instead of logic.

Program 5 'Preunit'
The children have to use arbitrary units to make simple measurements indicating their ability to use simple measurement techniques.

Program 6 'Ord/Vol'
The children have to use standard units to compare and measure the volumes of given cubes and cuboids.

Program 7 'Calcvol'
The children are asked to determine the number of units in a given layer and the number of layers in a given cuboid. The children must then indicate the calculation they would use to determine the cubic unit volume of the cuboid.

Program 8 'Logic/v'
The children have to deal with simple problems which involve the use of logic to establish conclusions.

M.E.P. Project
'Monitoring and Assessing Children's Conceptual Development'
<u>PACKAGE OUTLINE – AREA</u>

Program 1 'A/MATCH1'
The children are asked to sort and match shapes to determine their awareness of surface areas.

Program 2 'A/MATCH2'
The children have to analyse shapes and by using a composite number of shapes make a matching surface.

Program 3 'CATEG'
The children have to categorize shapes according to nominated successive attributes. The children have to use their observations of physical properties and their knowledge of shape terminology.

Program 4 'Scan'
The children are involved in the scanning of a number of given shapes and the analysis and matching of the shapes.

Program 5 'Conserv'
This program helps to distinguish between children relying solely on perceptual observations when dealing with conservation activities and those introducing logical reasoning into their conclusions.

Program 6 'Preunits'
The children have to use simple measurement techniques to determine area relationships.

Program 7 'Units'
The children are involved with the use of units to measure surface areas.

Program 8 '½ Unit'
The children have to use units and half units to measure shapes areas.

Program 9 'Grid'
The children have to measure shape areas using a grid measuring device.

Program 10 'A/LOGY'
The children are given problems to solve which highlight their ability to arrive at conclusions based on logic rather than simple observations or trial and error.

The programs are intended for children in the 7-11 age range, and are to be used at selected intervals after children have encountered learning experiences relevant to each key stage. Once the teacher feels that a child has acquired all the necessary information and expertise within a stage, then an assessment program can be used. The programs can help to confirm that the child has a good understanding of the stage, or it can present evidence of misunderstandings, the lack of application on mastery, and the need for compensatory work.

Practically all the programs are used with some kind of supporting apparatus. Because of the assessment nature of the results, indications of success or failure are not given to the children. Surprisingly, we find simply to say 'Thank you, you have finished' seems to satisfy the children, and in all the evaluation reports no-one remarked that any child had showed concern. Even when programs are repeated, the children do not seem to identify this with failure. The use of random elements and the facility for teachers to change program apparatus allows the programs to be successfully re-used.

The results shown at the end of each program are in the form of a diagnostic readout; the computer will keep the results of up to six children's attempts at a time. At the end of the lesson or when convenient, the teacher can call up the results. They can note each child's progress on a simple check list designed to be used in conjunction with the programs, or ask for a print out of the results for one child or the whole group. The print out can be used to create individual records or used for reference for the check list which shows details of experiences provided, the child's stage level, and the use of compensatory work.

The programs are not intended to dictate standards, but to present information regarding children's understandings at particular learning stages, *neither* are they intended to replace the vitally important teacher/child interaction necessary in assessment. The teacher is to use the information supplied by the computer to focus on the direction of the interaction making it relevant, meaningful and productive. It is hoped that the programs will provide the teacher with a structured system of easily administered assessment opportunities, and in turn help the teacher with the decisions to be made regarding the provision of the most appropriate learning experiences.

The results obtained through the programs, as hoped, gave us a vast amount of information, again too much to mention in this short report. Teachers received many unexpected facts to consider about their children. Many results held implications on how concepts were being taught, and reflected the narrowness of children's experiences and the lack of structure within the experiences. This is an example of the readout from Weight Prog. 6.

Units Prog. 6
Name ....

	No. attempts (First Part weighing)	Child's Ans. Given. (2nd part relationship)	Cor. Ans.	
1) Arb. units	1	8	12	X
2) Arb. units	1	5	5	C
3) Grams	1	GREEN	RED	X
4) Grams	1	BLUE	BLUE	C
5) Grams	1	PINK	YELLOW	X

In this program the children are asked to weigh some coloured boxes first (Questions 1, 2) using arbitrary units and then using grams, (Questions 3, 4, 5). Using their findings the children are then asked to find boxes which are twice as much, (1, 3) half as much (2, 4) and equal (5). We found that the majority of children were very accurate when weighing boxes, but then had difficulty in using the information. It was obvious that ensuring children can weigh accurately does not guarantee that they will then be able to sort out, categorize or pursue implications about their findings. This is an example of the readout from Area Program 7.

UNITS Prog. 7
Name ....

Correct Area	False Perim	Length +Width	Length XWidth	Method Unknown
10	0	0	1	0

The program asks the children to determine the area of some given shapes. By the answer given the computer indicates the most likely method the child has used, e.g. counting perimeter etc. In this situation a high number of children applied L × B even to irregular shapes. It would appear that many children were encouraged to achieve number answers before really practically and fully exploring the concept of measurement of area.

It is anticipated that the assessment programs will eventually be used on network systems. When a child has completed a program the teacher can instruct the classroom computer to obtain the child's file from a centrally based computer, the new results can be automatically added to the file. The teacher would have access to any child's updated records at any time; they could also obtain a progress overview of a group or class in any selected concept. In our school at the moment we are using a Level 1 BBC Econet system, which is very limited. We are hoping that we will soon have a level 2 system, which should then handle a central filing system that will enable us to establish a computer aided assessment and record system.

Other programs developed
In addition to the Mathematical packages further programs have been produced on 'Classification' and 'Comprehension'. The comprehension programs present the children with a series of pictures and sentences. The matching of the pictures and sentences involves the successful comprehension of certain grammatical structures, e.g. the use of negative or relative clauses, the use of masculine and feminine pronouns etc.

The Classification package contains seven programs. This package looks at children's classification skills from simple classifying by similarities and differences, to categorizing and grouping by different concept principles. Classification skills are applicable across the curriculum, but particularly in the mastering of language and other representational systems. Their importance can be directly related to computer information retrieval. They are also related to problem solving and logical thinking strategies. The program package contains the following:

Program 1 Classifying by one attribute
Program 2 Classifying by one attribute (randomized)
Program 3 Classifying by more than one attribute
Program 4 Sequential Classification
Program 5 Classification by function
Program 6 Classification by a common characteristic
Program 7 Classification by a principle

Outcomes
The original purpose of the project was to try and develop a computer supported system which enabled teachers to gain more knowledge about their children, and to a great extent this has been achieved. However, the most significant outcome of the project has been the amount of knowledge teachers gained about themselves and the way they teach. The children's assessment programs became tools for teacher self-evaluation. The teachers found the programs guided them towards children's specific difficulties, and also directed them to questionable correlated teaching structures and methods. As with any research project it can be guaranteed that some wrong decisions have been made and outcomes could have been better, but the project has been successful in pioneering a system of computer use specifically designed to be of practical value to practising teachers.

Exploring micros and record-keeping in nurseries by Elizabeth Moore,

*the University of Oxford Department of Social and Administrative Studies.**

Micros are already being used in the homes of many families with under-fives and it seems likely that the micro will become more available in nursery schools and classes in the future. It is now known that Great Britain leads the world by having more micros per school pupil than any other nation. Hence there is a need to consider the possibilities for exploiting the micro's potential both for pupils and staff. Work towards this was undertaken by the author and a summary of some of the results is given below.

The research project
In order to investigate the use of micros for record-keeping the staff in thirty-eight nursery classrooms used a microcomputer system for an experimental period of one week. They maintained their micro-based record-keeping system beyond this period by means of simulation sheets. The nursery nurses and nursery teachers could edit and embellish their micro-based systems as much as they wished but no computer programming skills were required.

Most of the nursery staff in this experimental programme chose to use a framework of headings under which they could write narrative notes, and to use a checklist of preschool skills. Examples of broad headings are: cognition, social and emotional development, physical skills. The checklists might include items such as: the child can look at a book on own and turn pages from beginning to end, the child can hold a pencil correctly, the child mixes well with children of own age. The question of who should edit, read, and have responsibility for records was raised as well as what should be the format, structure, and content of records.

Considering the brevity of the project, and that almost none of the participants had prior experience of compu-

*The research was carried out at the School of Education, The Open University.

ters, it was remarkable that over two-thirds of the classrooms had members of staff who were able to operate the micro after minimal training. By their own reports many of the participants learned to use the system very quickly and found it easy to use. Nearly everyone found they could use the wordprocessing package and database package quite quickly and easily. When participants came to ranking the best ways of learning to use the micro these were:

1) being shown;
2) having the opportunity to practice on their own;
3) having a good set of instructions to follow.

Additional comments from participants reflected the difficulties some encountered with what they were expected to do: there were requests that future training of nursery staff should be set far away from the demands of the children and that full-time pre-service or in-service training sessions might be best. Although such long courses away from the classroom are not necessary for learning to use micro-based systems, they would allow staff time to reflect and to evaluate the educational implications of micro-based technology.

The present exploratory study took place in nursery classrooms staffed by nursery nurses and nursery teachers. Extremely favourable attitudes towards the micro as a record-keeping tool were apparent in over a third of the classrooms, but only a tiny minority were enthusiastic about the micro as a games device. Whilst members of staff were usually more than willing to try out the record-keeping packages they were much less interested in the games programs for older children and adults to use.

The micro as a picture-making device

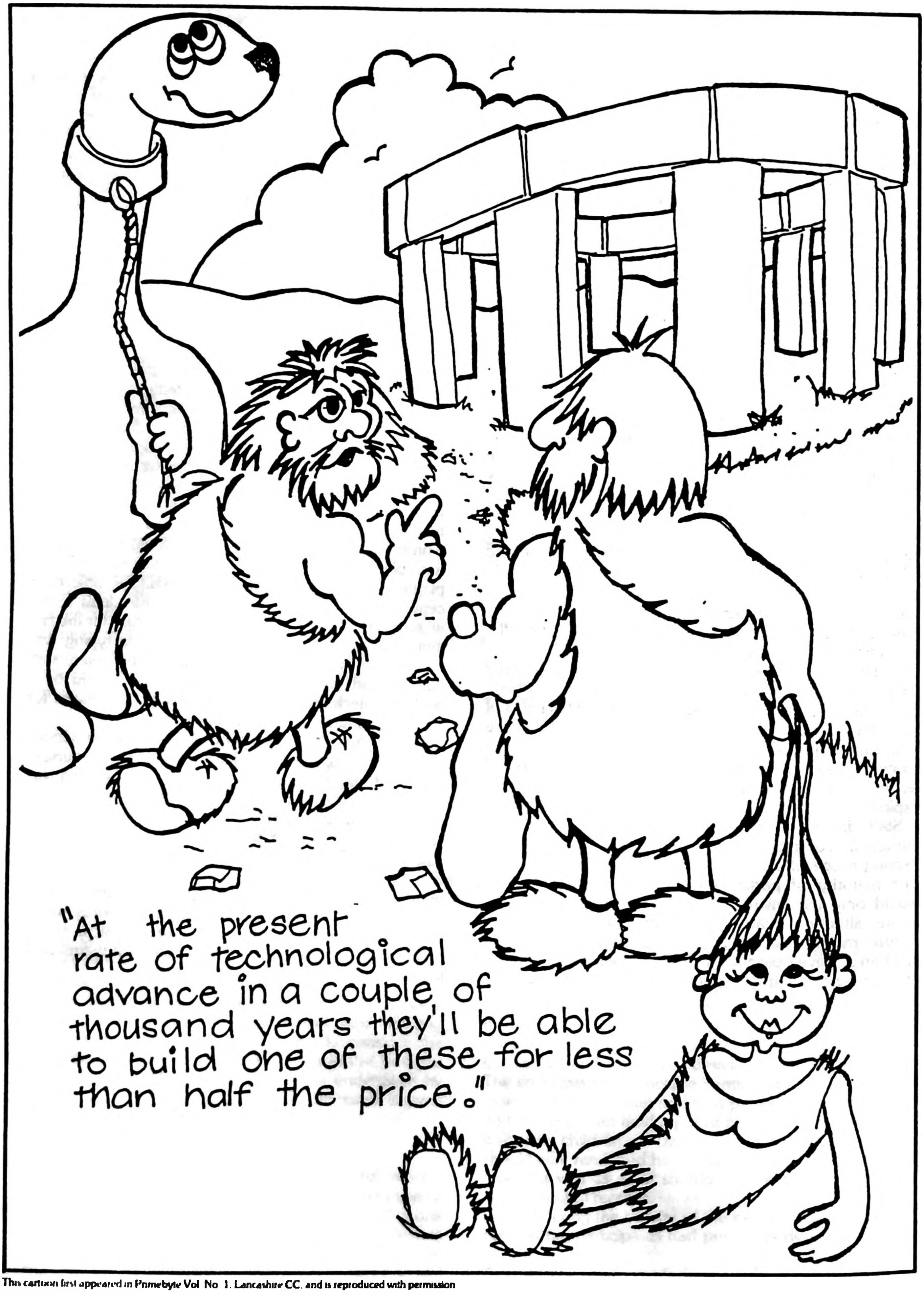
Almost all, on the other hand, were enthusiastic about the micro as a picture-making device for nursery children to use. The children pushed the arm of a micro-based pantograph device and chose from amongst the possibilities for colours they wanted to use as well as thickness of lines. The results of the children's use of the device were colourful and interesting for them to look at on the monitor screen and talk about. There were lots of special features of the micro which the enthusiasts could go on to exploit.

Staff did recommend restraint with regard to the introduction of micro-based drawing as an addition to the existing range of art equipment and materials on offer. The majority of participants thought nursery children would only use micros for a little of their time in the future, although nearly half added that a micro-based picture making device could help a lot with nursery children's development: including their concentration and understanding of spatial relations. For example, when children pushed the arm of the drawing device they would cause coloured splodges or thin lines to move in any direction they wished. The nursery nurse or teacher could intervene and discover the choices each child was making. Or the adult could focus on the excitement generated by the children and support their invention of fantasy stories to accompany the development of the screen images. The nursery staff who were more negative about micros for children's use said nurseries had a responsibility to present real life experiences to the under-fives and that micros should not be part of this. There seems a divide between those who welcome the micro as part of the real world and those who wish to shield children from it.

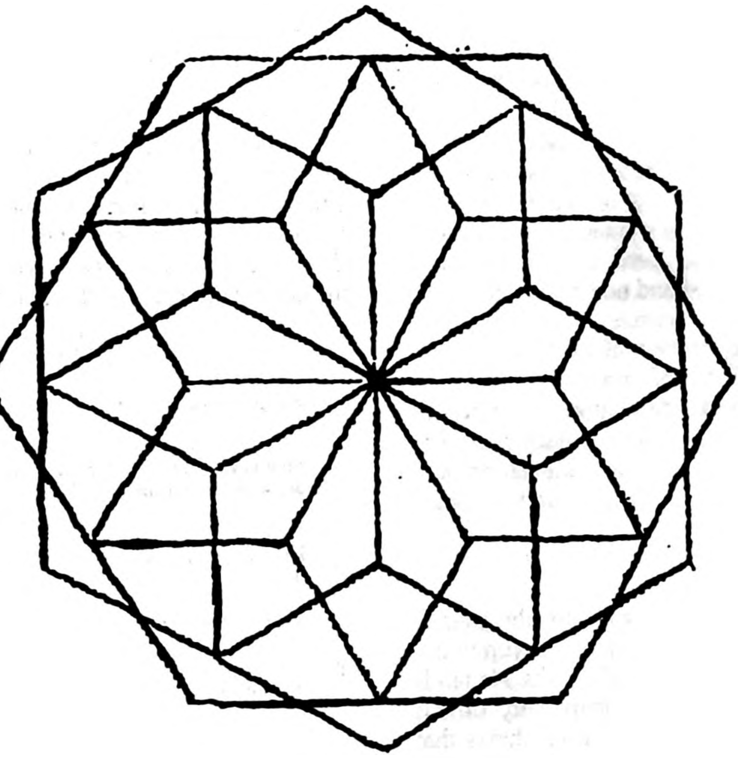
Will the micro be useful?

When participants were asked to conjecture about the usefulness of the micro in their own nursery an overwhelming majority judged that it would be useful, and that the database and wordprocessing packages in particular would be most useful. Participants did express some pessimism about the widespread use of micros for record-keeping in the future although more than half thought micro-based records would eventually be found in at least some nurseries. Some people wrote their comments about a micro system: most were in favour but a few spelt out their reservations. For example several mentioned high costs and that the micro would be too technical for them personally. Those in favour of the wordprocessing package thought it would help curriculum planning, noting of child observations, and the planning for individual children's needs. The objections centred on the difficulties that some individuals found when trying to manage a typewriter keyboard for the first time. For the database package very little typing was needed and people conjectured that once nursery staff had devised their checklist questions this would be a package which would offer time-saving possibilities for monitoring individual children's progress.

To conclude: everyone who took part gave serious thought as to how micros might be used in their nursery to benefit the children. Micro-based record-keeping was also judged to be a valid possibility. But before micros are installed in nurseries there are three necessary conditions: firstly, software that combines the best of wordprocessor, database, and graphical display facilities is needed for nursery record-keeping; secondly, there should be a printer to provide good quality printouts of either edited summaries or full versions of children's records when these are needed; and thirdly the nursery micro needs good picture-making facilities for the children themselves to use.



This cartoon first appeared in Primebyte Vol No 1, Lancashire CC, and is reproduced with permission



'So They Know About 360 ?' by Celia Hoyles, Rosamund Sutherland and Joan Evans

University of London Institute of Education.

Overview of Research

For the last year (1983/1984) we have carried out research in two London secondary school mathematics classrooms (fig 1). We have chosen to work in two first year mixed ability classrooms which have adopted a pupil-centred approach to the learning of Logo and the research is carried out during "normal" mathematics lessons. In one classroom the pupils have the use of two RML 380Z computers and in the other classrooms the pupils have the use of four Commodore 64 computers. The pupils work in pairs and are given the freedom initially to devise their own goals and decide how they might achieve them. This initial freedom is aimed at building up self confidence and self esteem. The ability to take responsibility for one's actions, to take risks and see what happens, to experiment and find out for oneself are all crucial elements for effective learning, that is, learning that can be used flexibly and creatively at a later date. We have also been experimenting with structured group tasks with specific learning objectives both in the area of mathematics and problem solving, and we see these as important in building links between the Logo activity and the "standard" mathematics curriculum.

Fig. 1

DETAILS OF MATHEMATICS CLASSES

	SCHOOL A	SCHOOL B
CURRICULUM	SMILE *	SMP ** 11-16
AGE OF PUPILS	11-12	11-12
No. IN CLASS	11 GIRLS 15 BOYS	15 GIRLS 15 BOYS
COMPUTER HARDWARE	2 RML 380Z	4 COMMODORE 64
MATHS/WEEK	4 x 55 Min	2 x 1 Hr 10 Min 1 x 45 Min (computer not used in this lesson)

* SMILE School Mathematics Individualised Learning Experiment

** SMP School Mathematics Project

As researchers we act as participant observers in the classroom conducting detailed case studies of four pairs of pupils from each school. Recordings of the pupils' Logo work and spoken language (the video recorder is connected between the computer and the monitor) provide, together with pupil and teacher interview data, an extremely powerful data base and allow the researchers to analyse in depth the progression in learning.

When and why we need to intervene during the pupils' Logo activity is being analysed and the consequences of these interventions in terms of the pupils' motivation and learning recorded. We are also analysing the nature and extent of collaborative work between the pupil pairs and how this is related to the goals chosen and to the mathematical processes and the problem solving strategies adopted.

In our analysis of the case study data we are finding many examples of the collaboration between the pupils stimulating mathematical discussion and investigation. The evidence so far points to the effectiveness of the pupils working in pairs, the importance of unstructured pupil-centred activity in building up confidence and motivation, the frequency of spontaneous occurrence of mathematical ideas and the need to develop more structured links between Logo and non-Logo contexts of mathematical concepts and processes.

In order to analyse and interpret all the data collected throughout the year we first of all immersed ourselves in the data and eventually decided upon an individual theme relevant to the Logo activity of each pair. The following is a description of one pair, and an analysis based around the theme of developing an understanding of 360 degrees as a total turn.

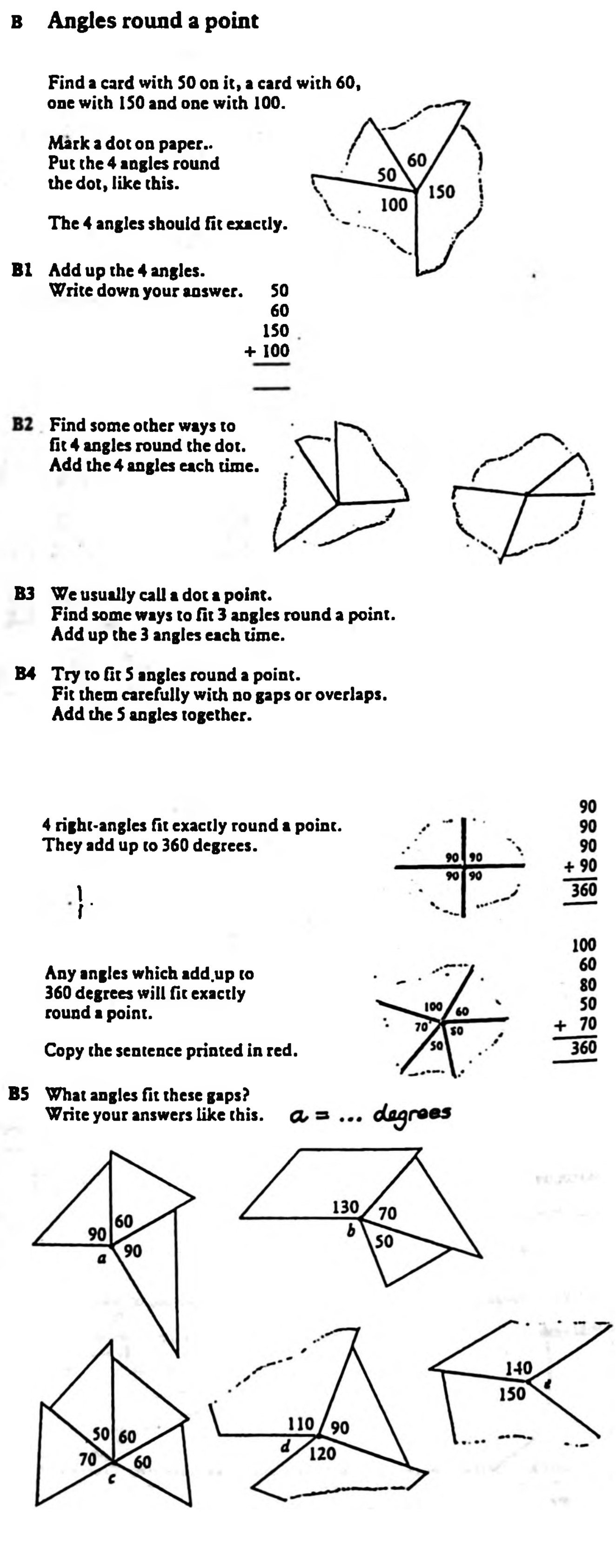
Panos and John – pupil profile

Panos is an outgoing friendly talkative boy who likes to be involved in everything that is going on. He communicates very freely with his peers and with adults. He tends to quite naturally give a running commentary on his thought processes. His mathematics teacher thinks that he is very gifted mathematically. He scored the highest mark in the class on the school's test of general intelligence and below average on Witkin's embedded figure's test indicating a tendency towards field independence. When we interviewed him he was very careful not to boast about his mathematical ability and said that his favourite subject at school is mathematics because "it is the only time that you work by yourself or with a friend . . . without the teacher telling you". One of his hobbies at home is "to do stuff with electrics . . . like building robots". When he was asked what he enjoyed most about his Logo work he said "The bit when we're actually . . . like there's something we're doing and it goes wrong . . . I like that bit". He goes on to say "it's enjoyable 'cos you have to think where it went wrong and all that . . ." He wrote that one of the good times in his mathematics lesson was "When we John and I were making a robot and we managed to get a moving picture . . . that was such a good time because it took us a long time and a lot of brain power."

John is a reserved boy with a friendly nature. He is popular and respected by his peers. His mathematics teacher considers that he has a high level of mathematical ability and that he is "generally prepared to solve problems himself rather than ask for help". It seems that he does not like to answer a question unless he is absolutely certain that his answer is correct. He obtained an above average score on the school's test of general intelligence and a below average score on Witkin's embedded figures test indicating a tendency towards field independence. John's favourite school lesson has always been mathematics and he enjoys it more now that there is a computer "as we're not just doing maths . . . we're seeing what patterns we can make in Logo". He thinks that working on the computer in his mathematics lesson is important because "It helps ummm it helps me to remember the things like . . . angles round a point equals 360 . . . and when I put it into the computer I remembered it". John thinks that he is slow at working things out in comparison to Panos. "He (Panos) can do sums quickly in his mind . . . and it takes me a long time . . . for the first test we had it took him six minutes . . . it took the rest of us quite a long time . . . and I only just finished it in the time we had . . ."

From studying the transcripts of Panos' and John's Logo work throughout the year 1983/1984 we have discovered a development in their understanding of 360 degrees as a total turn and an increase in terms of the range of contexts in which they are able to apply this knowledge confidently. In order to appreciate this case study it is important to note that Panos and John successfully completed work from Angle 1b and Angle 2A of the SMP 11 to 16 Booklets (Fig 2). These booklets included work on "Angles round a point equal 360".

Fig. 2


B Angles round a point

Find a card with 50 on it, a card with 60, one with 150 and one with 100.

Mark a dot on paper..
Put the 4 angles round the dot, like this.

The 4 angles should fit exactly.

B1 Add up the 4 angles.
Write down your answer.

50
60
150
+ 100

B2 Find some other ways to fit 4 angles round the dot.
Add the 4 angles each time.

B3 We usually call a dot a point.
Find some ways to fit 3 angles round a point.
Add up the 3 angles each time.

B4 Try to fit 5 angles round a point.
Fit them carefully with no gaps or overlaps.
Add the 5 angles together.

4 right-angles fit exactly round a point.
They add up to 360 degrees.

90
90
90
+ 90
360

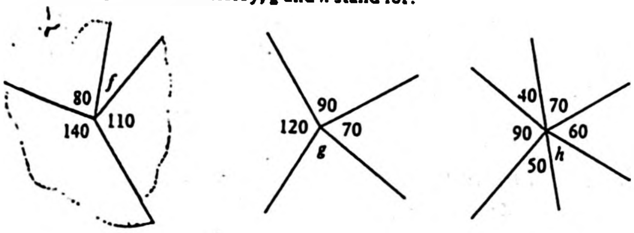
Any angles which add up to 360 degrees will fit exactly round a point.

Copy the sentence printed in red.

100
60
80
50
+ 70
360

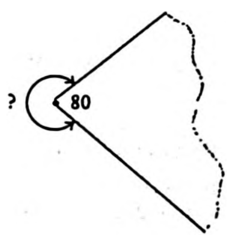
B5 What angles fit these gaps?
Write your answers like this. *a = ... degrees*

B6 What angles do the letters *f*, *g* and *h* stand for?

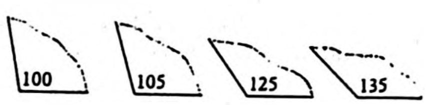


B7 Find a card with 80 on it.
Put it against a dot.

You need some more cards to go round the dot. Work out in your head some angles which will fit. Write them down.
Find those angles and check that they fit.



B8 Here are 4 angles.



3 of them will fit round a point.
Which 3 are they?

We have chosen the following phases related to this development. We suggest that these phases are hierarchical in that an ability to perform at one phase implies that the task could have been performed at any one of the preceeding phases. However the context and nature of the pupil project determines how the pair will perform at any one time.

Phase 1. Recalling with teacher assistance that there are 360 degrees in a circle and relating this to the drawing of a complete circle.

John and Panos had drawn a circle using the commands:–

REPEAT 70 [FD 5 RT 5]

and they asked how they could work out how many repeats they needed for one complete circle. We suggested that they think about how many degrees there are in a circle and in this context with considerable direction they were able to relate their knowledge about 360 degrees with Panos saying "*Oh so it's 360 divided by 5*".

They finally produced:–

REPEAT 72 [FD 5 RT 5]

Phase 2. Applying their knowledge of 360 in an experimental manner to the task of drawing an equilateral triangle.

Panos and John decided to draw an equilateral triangle. Panos predicted that the turning angle would be 60 degrees whereas John correctly predicted that it would be 120 degrees from the beginning. After some experimentation they drew the triangle correctly.

Phase 3. Experimenting in order to draw a complete 'small' circle.

Panos and John drew a circle:–

REPEAT 72 [FD 5 LT 5]

They decided they wanted to draw a smaller circle.

Panos initially showed a lack of understanding about the relationship between the number of turns and the turning angle:–

Panos: "*Hey John if we cut the step to 2.5 and we double the 72 do you think it would work?*"

John replied:

John: "*Might*".

They actually halved both 'step' and angle and typed:–

REPEAT 144 [FD 2.5 LD 2.5]

This produced another circle the same size as the first (going over it twice).

Panos then thought again and suggested that they modify the number of repeats. He had noticed that they had twice the number required.

Panos: "*Do you know what is wrong we'll leave it at 2.5 and 2.5 and just do it 72 times*".

John said:

John: "*O.K.*"

So they typed:–

REPEAT 72 [FD 2.5 LT 2.5]

but before the turtle actually started to draw Panos, who was reflecting on the outcome, correctly predicted:

Panos: "*It won't work . . . it will only go a little distance . . . half way*".

They asked for help and we intervened:–

I: "*Why don't you try different values of FD and LT?*"

This intervention nudged them into trying:–

REPEAT 72 [FD 2.5 LT 5]

which drew the required smaller circle. They defined this as a procedure called J.

Phase 4. Producing a complete rotated pattern of regular polygons by trial and error and counting.

Panos and John had produced a rotated pattern of small circles with a turning angle of 22.5 and 50 REPEATS. They knew that this produced more than one complete pattern and counted the number of circles on the screen to work out how many they would need just to complete the pattern. They worked out that they needed 16 REPEATS when the turning angle was 22.5. They did not relate these two numbers to 360 degrees.

John wanted to experiment more using different angles but Panos was not interested.

Phase 5. Producing a complete rotated pattern of regular polygons by using a halving and doubling strategy on the appropriate numbers of an existing complete rotated pattern.

Panos and John had already produced a complete rotated pattern of circles using a turning angle of 22.4 and a procedure J which drew a small circle.

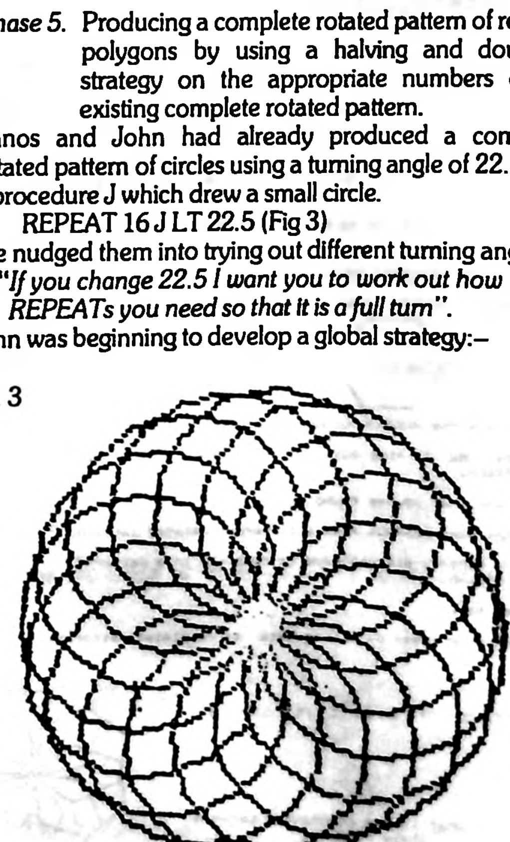
REPEAT 16 J LT 22.5 (Fig 3)

We nudged them into trying out different turning angles:–

I: "*If you change 22.5 I want you to work out how many REPEATs you need so that it is a full turn*".

John was beginning to develop a global strategy:–

Fig. 3



John: *"It's 'cos of the gaps . . . if it were a smaller gap . . . there'd need more circles to go round".*

They tried:–

REPEAT 16 [J LT 60]

and John said:

John: *"See bigger gaps . . . so you need less circles".*

They counted and realised that they needed 6 circles. At this stage Panos realised that there was a relationship between the 6 and the 60 but he incorrectly predicted what this could be:–

Panos: *"How about if we tried 50 . . . would there be 5?"*

John realised that this conjecture was incorrect because of his global understanding of the problem:–

John: *"No there'd be more . . . it'd be more for 50 . . . 'cos it'd be smaller gaps so it'd be more circles to go round . . . I don't think he understands . . . (to researcher)".*

This prompted Panos to change his conjecture:–

Panos: *"I do . . . every smaller gap . . . the small . . . the bigger the gaps they are the more . . . the more times you need to . . . well the less there are the more you need".*

John: *"Yeah . . . got it right . . ."*

They then used a turn of 30 degrees but again counted how many REPEATS were needed on the screen. When trying a turning angle of 15 Panos developed a halving and doubling strategy; that is, he saw that the number of REPEATS would be double that used when the turn was 30 degrees.

Panos: "Cos *when we done the 30 one it took twelve and it gets smaller . . . so I doubled the amount . . . miss and 6 took 60 . . . 60 took 6 which is half and the 60 is double the 30 . . . so it actually took half . . ."*

They then produced:–

REPEAT 24 [J LT 15]

and finally:–

REPEAT 3 [J LT 120]

Phase 6. Producing a complete rotated pattern of regular polygons by scaling appropriately the number of REPEATs and the turn in an existing complete rotated pattern.

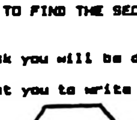
Fig. 4

ROTATED PATTERNS

TO FIND THE SECRET OF THE COMPLETE PATTERN

For this task you will be divided into groups of four.

First we want you to write a procedure to draw a HEXAGON.



TO HEX
REPEAT 6 [FD 50 RT 60]
END

Then rotate the HEXAGON to make a pattern – use the REPEAT command.

We want you to find out HOW MANY REPEATS YOU NEED to complete the pattern.

Write down what you've found out.

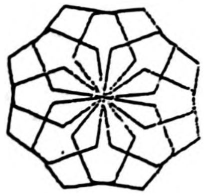
Using the same HEXAGON make a different rotated pattern.

How many REPEATs did you need to complete this pattern?
Write it down.

Try some more!

Test out your ideas by making lots of completed patterns.

REPEAT ? [HEX RT ?]



What is the connection between
these numbers.

In a structured task (Fig 4) Panos and John were asked to investigate the relationship between the number of REPEATs and the turning angle in order to obtain a complete rotated pattern.

Panos initially extended his halving and doubling strategy to 'tripling and thirding'.

Panos: *"I'm thinking how to do it for 18 . . . it's not that easy . . . 24 . . . if 6 is 60 . . . I think it is 20 . . . 60 divided by 3 is . . ."*

He then generalised this strategy still further by using a variety of scale factors e.g. multiplying number of REPEATs by 5 and dividing the turn by 5.

Phase 7. Understanding and Using the number relationships required for a complete rotated pattern.

In order to encourage Panos to develop a global idea of the task rather than rely on his step by step 'scaling' strategy we hid all their written records. These had listed all the commands for the complete patterns that they had already discovered. We also suggested that they try to find the turning angle for 20 REPEATs. Lucy who was also in the group suddenly had a flash of insight.

Lucy: *"I think it is 28 . . . 'cos 20 into 360 is 28."*

They tried this but because of the incorrect arithmetic their conjecture was not supported. Lucy was visibly puzzled and upset. Panos however checked the arithmetic and said:

Panos: *"360 divided by 20 is 18 not 28."*

They tried this and were delighted with the result. Panos then wanted to try out 'their magic way' with another specific example.

Panos: *". . .miss we've got a plan now . . . we've got a technique . . . let's do 36 and see if the plan works out."*

By the end of the session both Panos and John were able to use the relationship between the number of REPEATs, the turn and 360 in this activity and were able to articulate this relationship.

Panos wrote:–

Both the numbers timesed together = 360

John wrote:–

If you times both numbers they equal 360

Phase 8. Producing regular polygons and using a generalised procedure for a polygon using input.

In this session Panos and John were asked to write some procedures for regular polygons. They defined a pentagon and a hexagon without any difficulty but when they started on a triangle they defined:–

REPEAT 3 [LT 60 FD 60]

When this did not work Panos said:

Panos: *"REPEAT 3 TIMES ..60..60..it's 60 I'm sure . . . 'cos remember equilateral triangles have 60 degree angles . . ."*

But in direct drive John started to type:–

REPEAT 3 [RT 120 FD 60]

When this worked and Panos asked him how he did it, John replied:

John: *"It's 120 . . . Look . . . it's 360 around a point and you've got to . . . so it's 120 . . ."*

After defining the triangle procedure they then defined in the editor procedures to draw a nine, seven and eleven sided polygon. They did not check if they actually worked. When asked how they knew what to do, Panos said:

Panos: *"Whenever . . . say we like we're making a 12 sided shape . . . we have to use 12 times . . .*

REPEAT 12 . . . and that's ummm the numbers that we use you know besides the REPEAT . . . the angles that we use are factors of 360 . . ."

We then introduced to them the idea of drawing a general regular polygon using an input:–

```
TO SHAPES :NUMBER
REPEAT :NUMBER FD 40 LT 360/:NUMBER
END
```

Panos wanted to now rotate their SHAPES procedure:–

Panos: *"Miss I thought of something. If we put REPEAT SHAPES 5 . . . no REPEAT 36 . . . SHAPES 5 it might go completely round I think."*

They tried this and confidently explored rotated patterns using SHAPES. Panos did not realise that there had been any development of his understanding of 360 degrees. When asked why he had used 360, he said:

Panos: *"Because that's the number round a point . . . I knew it . . . they used to teach us that in our old school. It's the only thing they did teach us. Miss, they used to go on and on about it."*

Phase 9. Using a circle as part of a larger project.

Panos and John had managed to write a procedure to draw a matchstick man in which one arm waved and then one leg kicked in a sequential manner. Panos wanted to extend the project.

Panos: *"Miss it's going to play football . . . remember we can make small footballs . . . remember when we found out how to make the small ones."*

John demonstrated his understanding of 360 degrees as a complete turn by typing:

REPEAT 72 [FD 2.5 RT 5]

Panos thought that this was too big and said:

Panos: *"Oh you fishhead . . . the football's too big . . . make it really small . . . so that should be FD .5 . . ."*

He then changed his mind and decided that the FORWARD distance should be 1 and so they typed:

REPEAT 72 [FD 1 RT 5]

We then intervened to discover how much they understood about 360 degrees as a total turn.

I: *"If you changed that RT 5 . . . would that make it bigger or smaller . . ."*

John used the 360 degree rule and changed the command to:

REPEAT 180 [FD 1 RT 2]

Fig 5 gives a listing of their final procedure for a moving man kicking a football.

Conclusion

Studying John and Panos's developing understanding of 360 degrees as a total turn has highlighted for us:–

– The importance of allowing pupils to discover for themselves within a framework of interventions which encourage reflections about how the amount of turn relates to 360 degrees. John and Panos were eventually able to use the notion of total turn in the context of:

Drawing regular polygons.
Drawing different sized circles.
Drawing rotated patterns.

– The lack of initial transfer from a 'rote' understanding of 360 degrees as the sum of the angles round a point and ability to use this in a static context to the dynamic 360 degrees as a total turn.

– The individual ways pupils perceive and cope with a problem. Panos and John developed very different strategies for dealing with the total turn. Panos used a halving and doubling strategy which extended into the use of proportion while John used a global strategy of "the smaller the gap the more circles you'd need".

– the importance of a structured task arising from pupil activity in developing understanding. The rotated shape group task provoked John and Panos to reflect on their own strategies for dealing with the total turtle turn.

– The inadequacy of "telling" pupils a rule. Our intervention to tell John and Panos the rule of 360 in their second session had no effect on their subsequent activity.

– The importance of the role of collaboration in pupils' developing understanding. John was able to interpret Panos's ideas at a concrete level and Panos benefited from John's more systematic approach to the task of recording commands and typing in procedures. By the end of the year both Panos and John were becoming sensitive to each other's conceptual difficulties and were both able to take on an explanatory teaching role when they perceived that the other was having difficulty in understanding a problem.

```
TO BODY2
 HT
 HEAD
 JOINT
 ARM1
 BODY1
 LEGS
 ARM2
 PU
 RT 120
 FD 135
 PD
 BALL
END

TO JOINT
 RT 90
 FD 20
 RT 90
 FD 10
END

TO ARM1
 RT 45
 FD 50
 BK 50
 LT 45
END

TO HEAD
 PU
 FD 90
 PD
 REPEAT 4 [FD 40 RT 90]
END

TO BALL
 REPEAT 72 [FD 1 RT 5]
END

TO ARM2
 RT 90
 FD 20
 LT 90
 FD 77
 RT 135
 PD
 FD 50
 PENERASE
 BK 50
 PC 1
 LT 3
 FD 50
 REPEAT 25 [PENERASE BK 50 PC 1 LT 3 FD 50 WAIT 0.005]
END

TO LEGS
 LT 30
 FD 50
 BK 50
 RT 60
 FD 50

 REPEAT 20 [PENERASE BK 50 PC 1 RT 3 FD 50 WAIT 0.005]
 PU
 HOME
END

TO WAIT :SECONDS
 REPEAT :SECONDS * 300 []
END
```

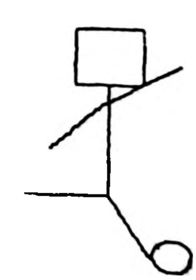


Fig. 5

The Future

Panos and John are only one of our pupil pairs and the case studies of all the pairs are to be published in January 1985.

The research project is continuing until August 1986 and we propose to:–

– continue studying the case study pairs throughout their next two years of schooling.

– Extend the case study research into a wider network of ten schools to note similarities and differences between classrooms.

– Carry out pilot work on integrating Logo into the mathematics curriculum.

A New Approach to Infant and Early Primary Mathematics by Marlene Kliman

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Abstract

A computer-based mathematics environment that uses only a joystick for operation and requires no reading, typing, or understanding of numerals, has been developed for young and handicapped children. This environment, PI (Programming Icons), is essentially a concrete and simplified version of Logo with added features that allow children to create interactive mathematical games. Pilot testing has shown PI to be an extremely motivating context for young children's mathematical work. Although PI is designed as a self-structured environment within which children are largely free to engage in self-directed and original work, it is nonetheless compatible with either a structured or open-ended teaching approach.

This paper describes PI, and provides observations, based on the results of pilot testing, on how PI can be used in the classroom.

1. Overview of PI

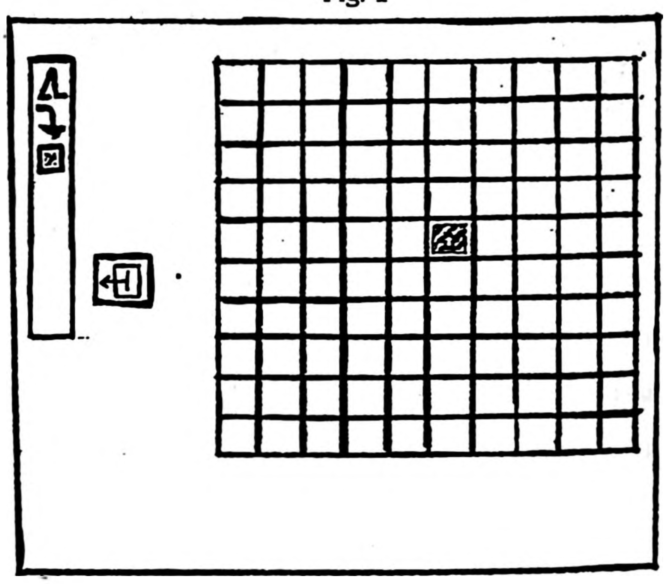
The increasing number of computers in primary schools has brought about the development of programming languages and other software designed to promote mathematical thinking in young children, e.g. [1, 3, 8]. Most of what is currently available relies on some reading, number, and typing ability. Often skills such as letter or word recognition, memorization of commands, or location of keys on a keyboard must be mastered before use of a particular piece of software can proceed fluently and without outside help. Learning to use these systems can prove frustrating for young children, particularly those who cannot read well or easily use a keyboard.

To help avoid some of these problems, letters, words, and symbols have been put on button boxes, concept keyboards [5], and other special input devices [9]. These input devices, however helpful, are limiting – they are expensive, and not versatile enough to be used for anything but very elementary and restricted work. Furthermore, relatively complex rules or syntax, additional commands, or limitations of the software itself can sometimes prevent young children from reaching a level of proficiency in which they can feel that they are doing anything very interesting or creative.

PI [Programming Icons] offers a more pragmatic and versatile approach. An iconographic programming language with accompanying mathematical game shells, PI requires no reading, typing, or ability with numerals. PI, therefore, has much wider accessibility than most educational software. Many children with mild physical handicaps can use PI, as it is operated with just a joystick.

Figure 1 shows the screen layout for programming with PI. PI contains an on-screen menu of icons for the Logo commands FORWARD, RIGHT, PENCOLOR, and CLEAR SCREEN, an icon for saving procedures, and a grid of large squares on which a turtle shaped like a grid square with an arrow in it can move. The icons are compatible with Bliss [4], an international iconographic communication system used with the handicapped. As the turtle moves and draws on the grid, an icon-sized representation of the grid is created. This icon can be saved and added to the menu, so that a new procedure is created. User-defined procedures, in turn, can be combined to create even higher-level procedures.

Fig. 1



PI is operated with a joystick that has a lever and at least one button. The lever is used for selecting the icon to be executed, and the button is used for executing icons. Additional joystick buttons can be used to control additional turtles. Since commands can be entered in any order and there is no chance for entering a misspelled or incorrect command, syntax errors are impossible.

Mathematical games of a wide range of complexity and difficulty can be created by using one of the game shells in conjunction with the PI grid, turtle, primitives, and user-defined procedures. Icons for saving and loading screen pictures, invoking counters for scorekeeping, and determining the rules of the game are present on a separate "rules screen". See [6, 7] for a more detailed description of the commands and operation of PI.

PI can serve as a bridge to mathematical notation, since numbers as well as icons may be used in constructing rules for mathematical games, and numeric repeat factors may be used with primitives and procedures. This feature was not added until after the pilot testing, and is discussed in more detail below.

2. Pilot Testing

2.1 Testing Conditions and Goals

In pilot testing (spring, 1984), a version of PI implemented on an Apple II microcomputer was used with seven children – six between the ages of five and seven, and one nine year old. The children worked with PI for an average of five 40 minute sessions each, alone or in pairs, over a period of about three weeks. Four of the children were from non-professional backgrounds and had never used a computer before.

Pilot testing was mainly concerned with making sure that PI is a viable system for young users and developing some activities for beginners. Testing was successful. The children became fairly fluent users of a slightly simplified version of PI after working with it for an average of about fifteen minutes. All the children exhibited great interest and enthusiasm in PI, and used the pre-designed games as a springboard for mathematical discussions and explorations, and for creative work, centring on designing, creating, debugging, and playing mathematical games.

Additional testing will be concerned with exploring the potential of PI as an environment for doing mathematics and with looking at the kinds of games and rules that children create over an extended period of time.

2.2. Learning to use PI

Children were introduced to PI with a slightly simplified version, essentially the version described above, without the screen clear and procedure saving icons. They were given a very brief introduction to its operation and were then encouraged to find out for themselves what the individual commands did.

Their immediate reaction was very positive. They were surprised and delighted that they could so easily control the turtle by making it move around the grid and draw in different colours. They quickly established what actions the three icons stood for, and began to draw multicoloured lines and corners on the screen. Within the first ten minutes, all of them, unprompted, intentionally drew all or most of a square or a rectangle. Five of the children became fairly competent users (i.e. they could state an intention to do something, such as draw a line in blue, turn, and change pen colour to green, and then do it) within the first five to fifteen minutes. The other two children did not master the commands until the second session.

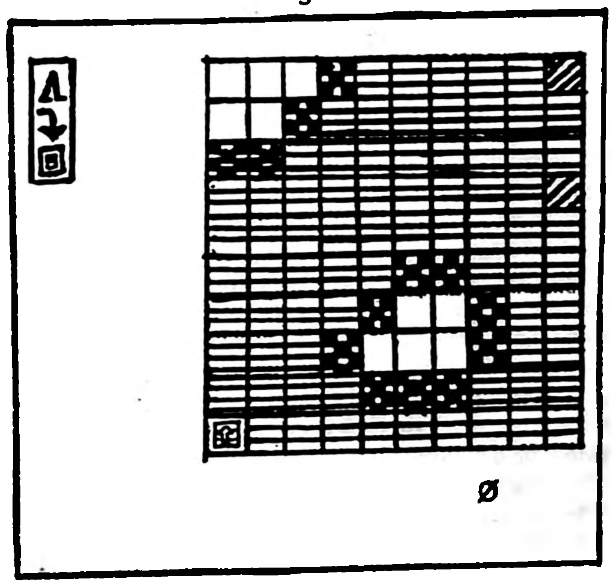
2.3 Pre-designed Mathematical Games

After initial exploration, many of the children seemed to lack the confidence and the initiative to continue to discover on their own what could be done with PI. Although they were able to suggest pictures and patterns that they might draw with PI, they did not, in general, feel ready to carry out these projects.

At this point, the children were, however, very interested in and challenged by a series of pre-designed games involving guiding the turtle through various paths, including mazes and obstacle courses. These games were successful in building up children's confidence, weaning them on to more creative and original mathematical work with PI, providing a context in which they could gain fluency with PI, encouraging simple mathematics such as counting, comparing, and measuring, and engendering a cooperative spirit.

A typical game is shown in Figure 2. The picture on the grid is meant to represent a body of water with two islands in it. Children were asked to move the turtle to the purple squares in the upper right corner (shown with diagonal stripes in Figure 2) without straying from the blue. They were given the option of using the on-screen counter (shown in the lower right part of the screen in Figure 2), to record the number of their turns and moves. Without exception, they preferred to use the counter in every game.

Fig. 2



Use of the counter seemed to promote mathematical thinking by encouraging the children to look for shortcuts and patterns. At first some of the children tended to be competitive, and simply tried to get a better score than the others, but they soon became curious about what other children did to achieve better scores. They began to work together to find the smallest number of moves needed to follow a particular path or get through a particular maze. This led to their discovering various properties of the system, for example, that it was possible to traverse some paths in more than one way, with the same number of moves, that four 90 degree turns bring the turtle back to its original position, or that the turtle "wraps" around the grid (when the turtle is at one end of the grid, pointing away from the centre, and is moved forward, it will appear at the opposite end of the grid, pointing toward the centre).

2.4 Game Shells for the Creation of Original Mathematical Games

The Board Game Shell

After working with pre-designed games for between one and two sessions, the children's confidence and facility with PI increased greatly, and they began to talk about what they would do if they could make up their own games with PI. At this point, one of the game shells, Board, was introduced. With Board, a natural extension of the pre-designed games that they had been playing, the children used PI to draw multicoloured game boards on the grid and made up rules to go along with them.

Most of the games created with Board required that players follow a path or change grid squares from one colour to another while trying to collect as many (or in some cases, as few) points as possible. Landing the turtle on a square of a particular colour would either raise or lower the score by a number of points or would change the turtle's position or orientation. In every game, children chose to use the counter to keep an on-screen tally of points. As the rules screen system for game rules input (essentially, a very user-friendly iconographic method of inputting and displaying rules) mentioned in Section 1 was not yet fully implemented, a different method was used. As a child stated a rule, the experimenter simply typed it into the computer, to be directly interpreted by Board. In this way, a game could be immediately created or changed.

Most of the games that the children first created with Board were quite simple. These games centred on moving the turtle to a particular goal square (i.e. "the blue square in the corner", or "the yellow square in the middle"). With each move, one point was added to or subtracted from the total score, depending on the colour of the square on which the turtle landed. Over time, however, children created Board games with much more intricate rules and goals. Typical rules created after children had worked with Board for one or two sessions involved adding and subtracting numbers other than one – for example, "if you land on red, you lose two points, if you land on green, your score goes back to zero". Some of the more advanced rules had more than one part – for example, "if you land on red, you lose three points and you have to go back to the beginning." Examples of the more complex goals developed include completing spirals or geometric figures, putting the missing colour into a pattern, and filling the entire grid in with one colour.

In order to win at these more complicated Board games, children developed strategies for maximizing scores. Typical strategies included landing on grid squares of particular colours to get more (or fewer) points or an automatic move to a more advantageous position, or avoiding squares of those colours that would produce less favourable results when landed on. Many of the more complicated games required that children do quite a bit of mathematics when creating game boards. For example, in creating boards for games that involved completing spirals or filling the missing colours into a pattern, children counted squares, compared side lengths, and looked at boards from different orientations.

The Tiles Game Shell

A different game shell, Tiles, was designed specifically to encourage this kind of geometric and spatial work. Using Tiles, children could create games involving tiling all or part of the grid with particular shapes. Children could pick the shapes with which they wanted to try to tile the grid from a pool of pre-designed shapes (in the future, children will be able to program these shapes themselves), and either simply try to fill the grid in a haphazard way, or decide on a structure for the game. A typical game might require that two players, each with a turtle assigned to draw a particular shape in a particular colour, work together to fill the grid by alternating tiles of different colours. Tiles games directly influenced the type of patterns and shapes that the children drew as Board game boards, and encouraged much discussion about grid-filling, and rotations and orientations of shapes.

Figure 3 shows a screen layout for a Tiles game that several of the children played. An icon representing a

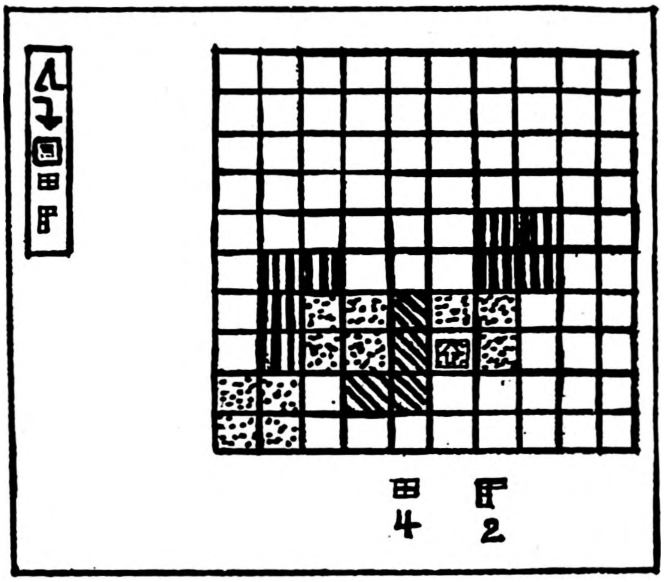


Fig. 3

square and one representing an L-shape have been added to the menu. When one of these icons is executed, the turtle draws the corresponding shape on the screen in the appropriate orientation. A toggle can be set so that shapes cannot overlap. In Figure 3, the grid has been partially filled, and the counters in the lower right indicate how many of each has been used.

The Chase Game Shell

The Chase game shell provided a particularly apt context for addition and subtraction, graphing, and visual thinking. With Chase, one or two players use turtles to try to "trap" a square moving around the grid in a geometric pattern. Each time a player moves or turns, the square moves one step in its pattern. Players must determine the square's path and then figure out how to intercept it so that they can land on the same grid square as the moving square. As with Tiles, Chase could be used for free play, or children could create rules determining more specific game rules such as the number of players, scoring, etc.

Some children using Chase found it helpful to first make a "map" of the square's path on a piece of large-squared graph paper. They located the square by using the screen grid as an X-Y coordinate system (e.g. counting out a position "four across and three from the bottom"), then found and marked the corresponding position on the squared paper. When the children numbered the positions in the square's path, they could tell where the square would be in a certain number of moves by counting up (or adding on) that number of moves from the number representing the square's position.

In pilot testing, the geometric patterns in which the square moved were selected from a pool of pre-designed patterns. In the future, children will be able to use PI to program these patterns themselves.

2.5 Programming with PI

While most of the testing sessions were spent working with mathematical games, three children spent much of one session just writing programs with PI (using the procedure-saving version of PI, described in Section 1). They had been told beforehand that they were going to be able to write programs next time, and were very excited about this, although they had little idea of what it entailed. When first programming with PI, the children all recognized that a miniature version of whatever was being created on the grid appeared at the lower right of the screen. They found the icons sensible and meaningful representations of the procedures they created and had no trouble remembering that executing the icons caused a similar picture to be created on the PI grid.

The children were amazed that the turtle was able to reproduce their patterns. Two of them spent much of the session running one or two procedures that they had created over and over again in different colours and in different orientations, intrigued with the variety that could be achieved. The third child worked at a more complex level. He did not merely use PI to create procedures out of primitives, he also combined procedures and primitives into higher-level procedures.

3. Numeric Repeat Factors

Several features were added to PI after pilot testing, the most significant of which is optional numeric repeat factors for use with primitives and procedures. The absence of repeat factors may actually encourage mathematical thinking in very young and beginning PI users, who must count individual grid squares in order to make a square, rectangle, or anything needing a precise side length. However, more sophisticated users may find that repeat factors (perhaps even written as mathematical expressions) can make programming faster and easier. Gradual substitution of numbers or mathematical expressions for continued repetition of commands can help children learn that numbers and mathematical expressions are a useful and meaningful shorthand for concrete operations on objects. Thus, children may develop a better understanding of numerals and perhaps other mathematical symbols, and they may acquire a better concept of the purpose of numeric inputs to commands, which will be helpful for later work in programming and mathematics.

4. PI in the Classroom

4.1 PI and Mathematics

Although the pilot study made no attempt to teach mathematics with PI, many observations on the possible use of PI in the classroom were made in the course of testing. PI provides a natural context in which to do simple mathematics – in free play with PI and in designing and playing mathematical games, children measured, compared, counted, added, and multiplied in order to determine how many of a certain shape could fit across the grid, how many moves would bring the turtle to a particular grid square, or how the best score could be achieved. Thus, the teacher favouring a fairly unstructured approach to mathematics might find that PI can provide the sort of Piagetian mathematics playground that helps to root mathematical structures and ideas in concrete experience. PI can be seen as a concrete and simplified version of Logo that also provides the motivational aspects and social benefits gained through creating interactive mathematical games. For the teacher with a more structured approach, PI is also useful because children can still complete a fairly precise exercise, such as "draw a five by three rectangle", or "tile the grid with these two shapes" in an original way. The orientation, starting point, and colours used to draw the rectangle need not be unique, and each child might use different colours and a slightly different pattern to fill the grid with the two shapes. Specific exercises requiring that children use PI to count, add, subtract, or perform other simple mathematics could easily be created.

An example of how PI might be used to teach multiplication comes from an observation of a child using Tiles. After spending some time filling an eight by eight grid with different shaped tiles made up of four squares, a seven year old, described by his teacher as average in mathematics, announced that sixteen of one type of any such tile (given that tiles can wrap around the grid) will always fill the grid "because there will always be sixty-four little squares." Excited about his discovery, he then went on to consider how many tiles composed of various numbers of squares would fill the grid. Perhaps this would have been a good time for a teacher to introduce the notation of multiplication, thus giving the boy a symbolic language in which to record, reflect on, and test some of his hypotheses and discoveries.

Unlike mathematical teaching aids of the past such as Cuisinaire rods and Dienes blocks [2, 10], PI does not simply give children concrete objects on which to perform mathematical operations without introducing them to the formal mathematical notation that represents their explorations and games and the mathematical structures that underly them. Because PI is computer-based, it is also able to provide counters and allow the option of using repeat factors with commands, and numbers and numeric expressions in establishing rules for games, so that children can begin to establish for themselves that formal arithmetic can be a useful and meaningful shorthand. Of course, a teacher's intervention in introducing appropriate symbolic notation, helping children to generalize and formalize their experiences with PI, and guiding and structuring the kinds of explorations and games created can also be extremely useful, if not crucial for many children.

4.2 PI and Logical Thinking

PI also can provide a natural context for developing logical thinking and debugging skills. When designing games, children occasionally gave conflicting rules or rules that did not correctly express what they wanted to happen. In these instances, the games did not work as intended. The children debugged faulty games by considering how the rules interacted to prevent the game from proceeding as intended. They then tried to figure out a way of changing the rules so that the game worked properly. Alternative rules were suggested, the experimenter typed them into the computer, and the revised game was played. In some cases, the goal of the game was changed in order to avoid complex rule revision.

A typical instance of game debugging occurred when a seven year old child created a game in which the object was to turn the entire grid green, while collecting as few points as possible. As the turtle moved around the grid, it turned each grid square on which it landed green. In this way, it was possible to turn the entire grid green. With each move, the score increased by one point. So far so good, but the one additional rule of this game introduced a problem. If the turtle ever landed on a green square, it was sent back to the starting square of the game, in this case, the lower left square of the grid. When the child played the game, she soon ran into difficulty. After about ten moves, she had trapped herself into a corner, and was unable to move. She had turned all the squares surrounding the starting square green, so that every time she tried to take a step in any direction, she was sent right back to the lower left corner.

The child had not anticipated that she could ever get trapped in a corner and wanted to eradicate this feature. Before she could go about changing the rules so that this situation could not occur, she had to figure out why she was trapped in the corner in the first place. In order to help her figure out what was wrong, the experimenter encouraged her to consider what happened when she landed on squares of the various colours, and she quickly came up with a way of getting around the problem. She began, "red, get a point . . . yellow, get a point . . . I know, lets make it draw in yellow!". Although her solution did not involve eliminating the troublesome rule that landing on green causes the turtle to return to the starting square, further questioning showed that she realized that this rule had caused the difficulty. She said she thought it was easier just to eliminate green from the board altogether, and stated that in the revised game, the turtle should draw in yellow and the new goal of the game should be to change the entire grid to yellow.

Although at no point during testing was the girl able to carefully scrutinize the full matrix of interacting rules to find bugs in games, after this debugging experience (her first), she became increasingly aware of possible conflicts and problems with game rules. She requested that the experimenter read out the rules of any game she created before she played it for the first time, so that she could try to identify any problems before actually playing the game. In this way, she occasionally found that two rules conflicted or that a rule that she had stated early on in designing the game was no longer appropriate.

This experience might have provided an ideal opportunity for a teacher to introduce some of the simple language of logic (such as if, then, or, and, not, etc.), so that the child would have had more of a language with which to formulate and express her ideas, hypotheses, and observations about rules. It is expected that the rules screen method of inputting game rules, currently under development, will help to give children a common language with which to discuss rules and related logical concepts. However, once again, a teacher's guidance in introducing notation and in helping children to generalize and formalize may be invaluable.

4.3 PI and Social Interaction

An important feature of PI is that it is intrinsically motivating, as children are always anxious to construct games for others to play. Children progress to more difficult levels of game playing as they seek to create harder and more unusual games to challenge, impress, and delight their friends. Thus, PI is particularly well suited to work in small groups. The atmosphere among children during pilot testing was, in general, very friendly and cooperative. Children enjoyed playing each others' games. Usually the game designer watched intently, offering or denying hints and suggestions, as others played his or her game. Sometimes the game designer would not tell the player the rules, or would only tell some of them, and would instead insist that the player discover the rules by moving the turtle around the board and noticing how the score changes and what happens to the turtle. Often a game would be suspended while children discussed how to make the game easier, harder, or more interesting, or talked over the advantages and disadvantages of a particular move.

5. Summary

PI is indeed a flexible, unusual, and highly motivating system. A concrete and simplified version of Logo with features that allow children to create interactive mathematical games, PI has much potential for classroom use. One likely reason that PI has proved to be so captivating is that it allows children to play an important part in constructing and manipulating their learning environments, but is internally structured enough so that even beginners can create viable mathematical games. Thus, PI is amenable to a wide range of teaching approaches, and can be used with very young and handicapped children as well as children who are slightly older and more capable.

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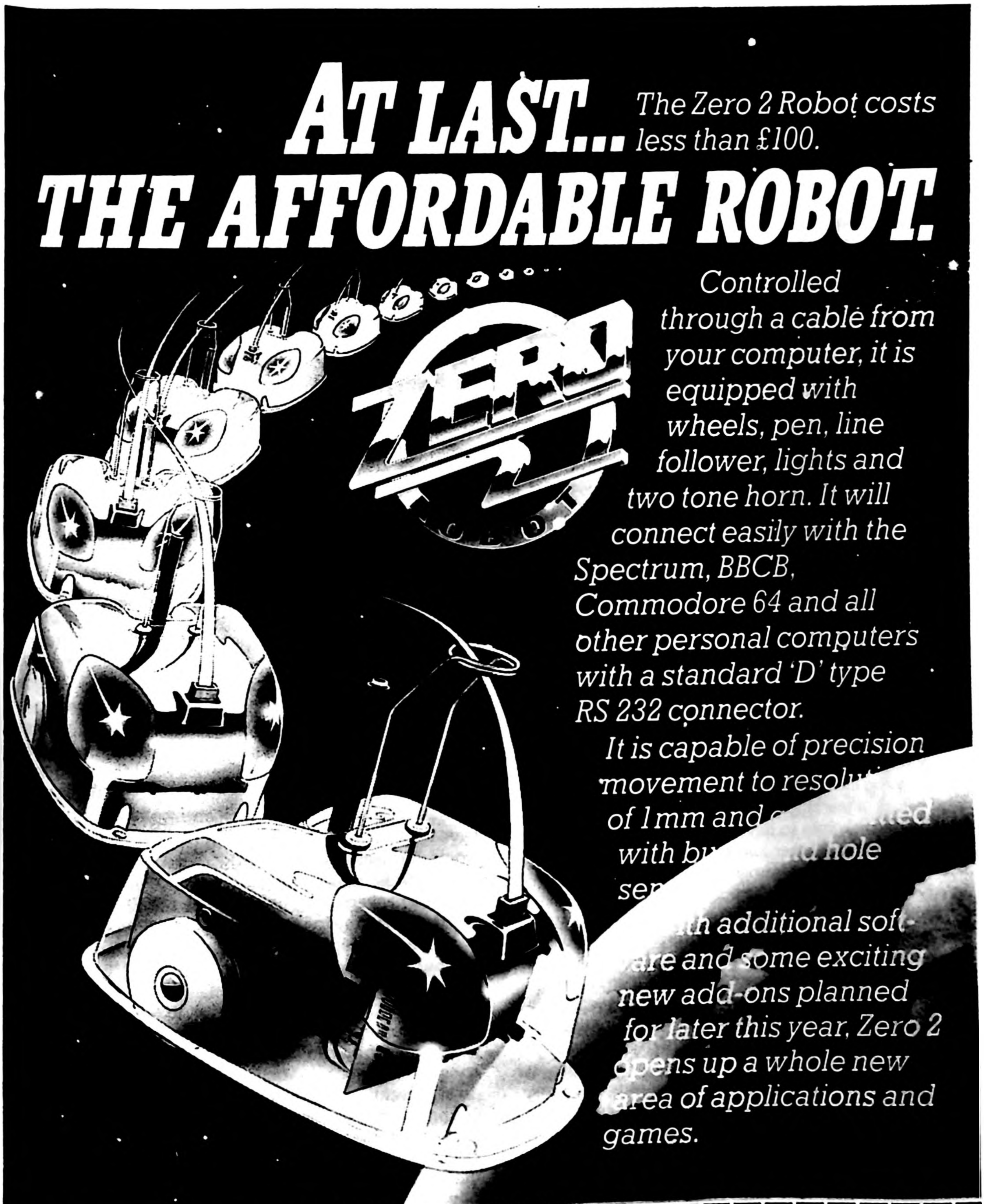

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Tools for Learning by Mike Sharples

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This paper describes 'tools for learning', an integrated package of software that will help a child to communicate, to acquire, store and manipulate knowledge and to investigate language, sound and pictures. In the short term, the package would be used for classroom problem-solving and project work but as home and portable computers become cheaper and more widespread, then the package could form part of each child's learning equipment, just as the pencil, ruler and pocket calculator do at present.

1. Surrogate Teachers

It is largely due to a coincidence of history that, until recently, the main thrust of development in computers and education has been towards producing 'surrogate teachers', computer programs that take on the role of a schoolteacher, providing structured teaching material, monitoring the learner's progress and administering tests of performance. In the mid 1950's, when computers first became available for research use, the dominant school of psychology, in the U.S. at least, was behaviourism. Behaviourists not only claimed to have a coherent theory of learning – operant conditioning – they also proposed that lessons could be administered by machine. Although mechanical devices were adequate, the digital computer, as a general purpose programmable symbol manipulator, was the ideal testbed for behaviourist theories of learning.

The early 1960's was a time of great promise for computer-assisted instruction, with predictions that the computer would take over the role of contact with the child, leaving a human teacher to plan the curriculum and tend a flock of teaching machines. A decade later, despite well-funded schemes to develop automated classrooms, the computer as teacher had turned out to be cumbersome, costly, difficult to program and, at very best, only as effective as a human in helping children to pass exams (O'Shea and Self, 1983, give a useful history of computers in education). Moreover there were shown to be good theoretical reasons why 'frame based' software (with the teaching material stored as prewritten chunks of text) was an inadequate substitute for a knowledgeable human teacher, leaving aside the values of human sympathy and contact. Hartley (1973) set down four principles for the design of computer assisted learning software that still stand as goals for software designers. He proposed that an 'adaptive' teaching program (one that could respond to the needs and limitations of individual learners) must contain explicit representations of the subject to be taught; the current state of the learner's knowledge; a teaching strategy; the means to apply the teaching strategy.

Since then a few programs have been designed that satisfy some or all of these criteria, but they have been, without exception, the result of major research projects and provide teaching in a very limited domain. The design of 'expert' teaching programs is still a difficult area of research.

2. Computer-Based Tools

Had computers arrived some twenty years later, the story might have been very different. In the early 1970's cognitive and developmental psychology was beginning to compete with behaviourism in providing theories of learning and in offering a role for computers in education:

> In many schools today the phrase 'computer-aided instruction' means making the computer teach the child. One might say that the computer is being used to program the child. In my vision the child programs the computer and, in doing so, both acquires a mastery over a piece of the most modern and powerful technology and establishes an intimate contact with some of the deepest ideas from science, from mathematics, and from the art of intellectual model building. (Papert, 1980)

At that time funds had been committed to large scale development and evaluation of teaching software – PLATO and TICCIT in the U.S., NDPCAL in Britain – and it was not until the advent of microcomputers (with an embarrassing lack of useful educational software) that wide recognition was given to the possibilities of the computer as a tool for learning.

Designing such tools is nowhere near as hard as building intelligent teaching systems. Computers are in widespread use as tools in commerce, science, journalism and design and the task is to adapt such programs as word processors, graphics packages, statistics packages and database systems for use by children. Logo, a derivative of the artificial intelligence programming language Lisp, is the best known example of a successful adaption, but there are others, such as the Edword, Word and Bank Street Writer word processors for children and the Microquery, LEEP and Factfile database packages.

From talking with teachers and software designers I have found a fair agreement on the basic set of tools that would be useful to a child aged 9-14. These include a word processor, a simple data collection, calculation and statistics package, a graphics package (with facilities for creating and transforming patterns, pictures and graphs), a database, a high-level programming language, and a communications package (allowing children to send and receive written messages). In the short term these programs would be designed for use in the classroom, but as home and portable computers become more widespread they could form part of every child's learning equipment, just as the pencil, ruler and pocket calculator do at present.

The computer need not only be a substitute for conventional classroom equipment such as typewriters, calculators or reference books. It has properties – such as the ability to simulate rule-governed systems, to mimic other machines and to display animated pictures – that could extend the scope and quality of a child's education. New types of educational tools include a program for exploring language, a music synthesiser, an engineering modeller, a dynamics modeller, a map designer and route planner, and a logic programming language. This is obviously only a partial list; other programs could be added, but for the rest of this paper I want to concentrate not on the individual programs (or modules), but on the general framework of the toolkit.

Most of the educational tools that are currently available are single, independent programs: the word processor cannot incorporate pictures produced by the graphics program; the graphics program cannot display results from the statistics program, and so on. A few attempts have been made to link tools together, but the programs have been slow and difficult to use. This is partly due to the limitations of current educational computers, but also because the enterprise has been seen as joining together individual component programs, rather than creating a single well-integrated system. In the world of business computing multi-purpose computer toolkits are now commonplace. Within five years computers with the power of current business systems will be commonly available in schools and the home, so now is the time for teachers to cooperate with programmers in the design of powerful and appropriate tools for learning.

3. A Design for a Toolkit

What follows is an outline design for a computer-based educational toolkit. Its value lies not only in the component modules – a statistics program, word processor, graphics program, database – but in the links between them. Its purpose is to help children to collect and set down knowledge – as text, pictures, or numbers – and manipulate and explore that knowledge by classifying it, making deductions and inferences from it, and by discovering patterns, permutations and underlying rules. As an example: Mary is involved in a project to investigate her school class. She devises a questionnaire and types it to the computer. Each child then comes over to answer the questions posed by the program, and when they have finished Mary has a record of all their responses. She can study the information about each child, or the class as a whole, or any subgroup (such as all the girls of age 11). Let's say she is interested in differences between boys and girls. She requests the average height of girls and of boys in the class, then for a bar chart of girls by age and of boys. She superimposes the two charts to see if there is any age at which the girls are on average taller than the boys. Having finished the investigation she writes an account, using a simple but powerful word processor. At any point while writing she can ask for a synonym of the current word, or its dictionary definition, or she can check the text for misspelt words. She can copy the graphs into the text, or include a command that allows the reader to query the database himself.

There are a number of criteria that need to be satisfied in order to build a toolkit of the type described above. The system must be:

(1) simple – so that a child with no knowledge of programming and minimal training can operate it.
(2) general purpose – it is not restricted to one area of the curriculum.
(3) powerful – it offers reference aids and facilities for manipulating text, pictures and numbers that are as good as current business systems.
(4) extensible – the child, or teacher, must be able to alter the system to suit special needs (extra help information, other types of reference aid) and to fit the components together to form new modules (a Prestel-type information system for example).

The first thing to consider in designing such a toolkit is how the parts fit together. Information needs to be passed as 'structured data' between the different modules, in a form that is general enough to represent any piece of text, or line drawing, or numerical value, simple enough to be created by a child with no knowledge of programming, and constrained enough to be manipulated by a program. Strings of words are no use for communicating between the modules. If we wanted the computer to do more than store and print them, then we would need to build a program that understood English text. Records, as used by programming languages such as Pascal for storing and operating on information in a standard form, are not suitable because their structure is too complex for anyone but an experienced programmer.

4. Representing Information

Fortunately, there are a few general operations on data that are common to a wide range of tasks. They are: storing information by name, looking up tables, picking matched items out of a group, generating random elements from a set. The operations are not unique to computing – filing notes in a filing cabinet, looking up a word in a dictionary, picking a set of cards from a card index, and throwing dice are examples of each type of operation – but for a computer to carry out these activities the information needs to be represented in a standardised form. Just two types of data structure – the phrasebook and the box – are sufficient for all the operations, and these are the sole means of storing and passing information within the toolkit.

The phrasebook is a direct analogy of a tourist's foreign language phrasebook. As well as phrases and their foreign equivalents, the book may contain any information that a child might want to look up: questions and their answers, words and synonyms, names and numbers. There is a different book for each application: dictionary, thesaurus, quiz book and so on. Instead of phrases, the right hand page may contain pictures, or pieces of program code to perform an operation.

The box is simply the equivalent of a physical box, labelled with a single word name and holding an assortment of paper slips, in no particular order. The slips might contain words, pictures, programs, phrasebooks, or even other boxes. Although the information is contained in a standard form, different programs can manipulate it in different ways: to build up a taxonomy, to create a database, as a grammar for generating or recognising sentences. Phrasebooks and boxes are described in more detail in Sharples, 1985.

5. Layers of Detail

Having decided on a method of representing information, we can now confront the problem of designing a toolkit that is powerful and easy to operate. One solution is to construct it in layers. The outer layer is for beginners: the child is guided through the operation of each module by prompts and help information on the screen and at the end of a session she names the product – a piece of text, a picture, a database and it is automatically saved under that name. The power of the system comes from the fact that every piece of information is stored either as a phrasebook or a box. To take the earlier example, the responses to the questionnaire are saved as phrasebooks, one for each person in the class, eg:

Book name: MARY

LEFT PAGE	RIGHT PAGE
Age	10
Height	160 cm
Hair	Fair

Phrasebooks for an entire class are stored in a box:

Box name: CLASS2E

Mary
Ian
John
etc.,

For the word processor, the dictionary and thesaurus are both phrasebooks, and when text is typed it is stored in a box and so on. This not only signficantly cuts down the number of different programs to manipulate the data – the same program can, for example, look up a dictionary, a thesaurus, or a response to a questionnaire – it also enables the data to be passed from one module to another: the contents of a phrasebook created by the statistics program can be displayed by the graphics package as, say, a bar chart.

The next layer of the toolkit provides commands to manipulate the phrasebooks and boxes directly, adding or removing entries, perhaps to extend the thesaurus or alter an entry in the database. For this the child would need to know about the form of phrasebooks and boxes.

To operate the next layer of the system the child (or more likely an adult) would need to know a little of the programming language from which the system was built and could 'bolt together' the phrasebooks and boxes into new modules. The programming skills need not be great, since the programming language would be a familiar and accessible one such as Logo, and only a few commands may be needed to construct a new module (Sharples, 1985, gives some examples).

The lowest layer of the toolkit contains the programs for the standard modules, such as the word processor. Since these would also be written in a high-level language like Logo then someone with a little knowledge of programming could alter them to suit the needs of particular children, say by adding new help information or changing the command names.

Building a toolkit in layers allows the child to work at her own level of understanding: a beginner can type in stories or create and alter pictures without knowing anything about phrasebooks, boxes, or Logo: an experienced user can delve deeper to tailor the toolkit to her own special needs.

6. Implementations

Toolkit systems built on the layer principle are in regular use for university teaching (the POPLOG system at Sussex University for example) and will soon appear in schools. The MEP Primary Project has commissioned a Logo toolkit for the BBC Micro, based on phrasebooks and boxes, and incorporating a simple statistics program, a one-keypress Logo designer, a language exploration program, and a shape transformation program. It will be available early summer 1985. The EEC has also funded a joint European project to build a powerful set of tools for the next generation of educational computers. These programs are still at the design stage; they need to be tested, refined and distributed, but it should not be long before computer toolkits become as accepted a part of school education as the pencil or pocket calculator.

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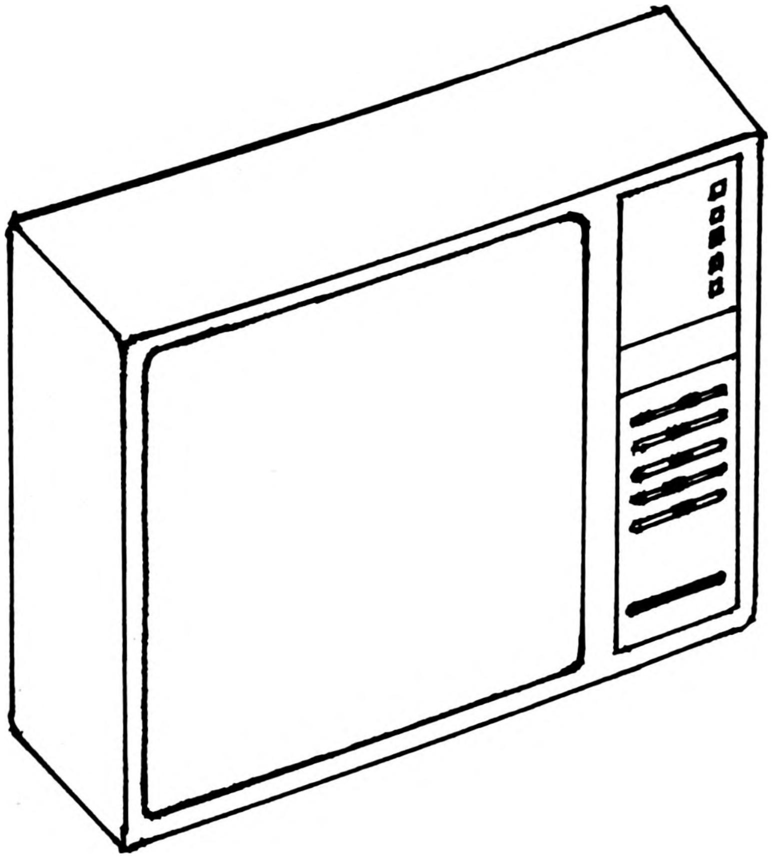

Viewdata, Teletext and Electronic Mail by Dr Jon Coupland

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For many years the collection and interpretation of information has formed part of the primary curriculum. As computers were introduced into schools they were recognised as suitable devices to assist in this activity. A range of software has been produced and is now widely used in schools, for example, FACTFILE, SEEK and QUEST.

In parallel with these educational developments the business community has pursued the access to, and distribution of, information. Frequently there was a need to make up to date information immediately available over large areas using computer links.

These developments have been closely followed by people involved in educational computing who felt that schools could also benefit from access to such information. There are three general styles of information distribution currently being explored in schools, viewdata, teletext and electronic mail. We will describe the principles of operation of each type by looking at particular examples.

Viewdata is the generic term for interactive information systems linked by cables. We will consider the British Telecom system called PRESTEL which is available nationally through the normal telephone service. Teletext is the generic term for non-interactive information systems, we will discuss the CEEFAX and ORACLE services provided by the BBC and ITV as part of television broadcasts. Electronic mail is a method of transmitting information between individuals. We will describe the Telecom Gold service and developments offered by The Times Network for Schools.

PRESTEL

PRESTEL is an information service available throughout the U.K. using the normal telephone system as a link. PRESTEL consists of pages of information (currently around one third of a million), which can be selected and displayed on a television screen. Special PRESTEL terminals can be purchased, but for schools the cost effective solution is to use the school computer and some special software to turn it into a PRESTEL terminal. To contact any information source over the telephone system a modem is required. This modulates the computer signals so that they are suitable for telephone transmission and demodulates signals coming back. Additionally you must be registered as a PRESTEL user to get the necessary identity codes and passwords to contact the system.

So to make contact with PRESTEL you must load the appropriate software into your computer and connect the modem between your computer and a telephone jack-socket. The PRESTEL computer number is dialled up and when contact has been made key in your ten digit identity code and then your four letter password. A page will be displayed with a menu of available routes to other pages. You can move through the information either by selecting a route from the menu displayed on the screen, or choosing the particular number of the page you require. PRESTEL regularly publish a directory of information available and the page numbers where it can be found. (A pleasing combination of the traditional printed word and the new technology). Pages on PRESTEL come from a large number of information sources; currently over 1200. Not all areas of PRESTEL are accessible. Some information providers (IPs) put their information into Closed User Groups (CUGs) and an additional subscription is payable to access them. However, you can normally get a feel for the information they provide before meeting a private page. Most pages schools would wish to access are freely available but a page charge can be made. You are always informed before you view a page if it carries a charge. Most charges are modest, around 5p for census data is typical.

The capability of computers to connect PRESTEL has enabled some new facilities to be provided. Pages displayed on the computer screen can be saved onto cassette or disc for later viewing. Additionally software can be received over PRESTEL, at present this is part of the Micronet 800 Closed User Group. Some of the software is free, some is charged. PRESTEL is an effective way to distribute software. The distributor does not have the overheads of mailing and processing orders. The software is lodged on the PRESTEL computer, the income resulting from it being downloaded and regularly credited to his firm. Naturally, software and pages downloaded are protected by the usual copyright regulations.

PRESTEL also supports a message service. Messages can be lodged in the PRESTEL computer for other users of the system and when they go onto PRESTEL they will be informed that they have messages to read. There are many other facilities available on PRESTEL. A Closed User Group operated by the Nottingham Building Society and The Bank of Scotland offers home banking facilities. Many brochures and information sheets can be ordered through PRESTEL. Tele-shopping is available in some areas, using Access or Barclaycard numbers to pay for transactions.

Costs:

The cost of using PRESTEL mounts in a variety of ways. To be a registered user of PRESTEL (i.e. to get an identity number and password) there is a standing charge of £6.50 a quarter for residential users and £18.00 a quarter for business users. Certain pages are charged and these will appear on your PRESTEL bill. You have to pay to use their computer during 'business' hours. From Monday to Friday between 8.00 a.m. and 6.00 p.m. and on Saturdays between 8.00 a.m. and 1.00 p.m. the cost is 6p a minute. Additionally, there is the telephone bill. Throughout your contact with the PRESTEL computer you are charged the normal telephone connect charge. There are six PRESTEL computers altogether and most areas of the U.K. can contact one at local call charge rates currently:

22p for 5 mins 9.00 a.m. – 1.00 p.m.	weekdays
16p for 5 mins 8.00 a.m. – 9.00 a.m. and 1.00 p.m. – 6.00 p.m.	weekdays
5p for 5 mins	other times

To summarise the costs include:

- standing charge
- time charge
- page charge
- telephone bill

Additionally there is the initial cost of a suitable modem. These vary in price between £50 and £150. A special PRESTEL education offer is now available to schools. This costs £49 a quarter, which includes 10 hours of time charges and £10 of page charges. It includes the PRESTEL standing charge and access to the Closed User Groups of Micronet 800 and VIEWFAX 258. It is estimated that including local rate telephone charges the total cost will be £250-£300 a year. At present the service is particularly designed for secondary schools and further education. For example, an extensive careers service is provided. Currently, the incorporation of materials relating to primary education is being considered. It also includes an in-service training course for teachers, the PRESTEL software and the offer of a £50 modem. For full details contact PRESTEL, Telephone House, Temple Avenue, London, EC4 OHL, Tel: 01-583-2790.

Considerations

PRESTEL is a very large information system available throughout the U.K. and usually accessed at local call rates. The information is structured as pages with routes selected from menus. However, the routes do not merely take you through a particular Information Provider's pages, 'Creepers' frequently take you across the data base into fresh areas. This facility to, almost unknowingly, flip between different sets of information is a great advantage that electronic information has over that available in a collection of books. In some ways PRESTEL is quite old fashioned, the information is displayed as text with boxy graphics. The only routing is through numbers and no keyword searching is available. The costs associated with PRESTEL causes a major dilemma when considering its educational use. It is clear that it offers facilities for children to pursue their own lines of enquiry. They frequently 'discover' information they would not anticipate being related to their topic. However its use in school time with time charges and high telephone charges is limited. It is possible for the teacher to download pages from PRESTEL when time changes do not apply and at cheap rate telephone lines, but this negates the whole principle of an interactive information service.

Additionally there are serious management problems. It is possible to run up very high page charges when connected to the system and there may well be problems if a standard telephone is freely available in a classroom.

CEEFAX and ORACLE

CEEFAX and ORACLE are the teletext services provided by the BBC and ITV. Pages of information are transmitted as part of the normal television transmissions. A special television set or teletext adapter allows a page to be trapped, stored and displayed on the screen. The pages are broadcast in sequence and so there may well be a delay before a chosen page arrives. This is a non-interactive system, the only connection with the information service being the television aerial. Once a special television set or adapter has been purchased then no further cost is met. Indeed, the broadcaster of such services does not know who is receiving the pages. Clearly a limitation of such a system is the number of pages that can be provided. The more pages made available the greater the delay that may be met before a selected page arrives for viewing. The four systems, on BBC1, BBC2, ITV and Channel 4 currently each offer around 100 pages each. A particular page number can have a number of frames, an example is the newsreel page which may cycle through twenty or thirty frames.

With a teletext television pages can be viewed, but a teletext adapter for a computer allows pages to be both viewed and downloaded onto disc or cassette. Indeed this facility has been exploited to make software available which can be downloaded and then run on a computer. The only problem being the cost and availability of the teletext adapters. Currently the only ones available are from Acorn for the BBC computer costing around £200 and from OEL for the Spectrum at around £140. It is to be hoped that cheaper models available for a range of computers will soon be produced.

There are many plans to extend the facilities of teletext. By using some more spare lines in the television signal more pages will be provided. Additionally advanced memory chips in either television sets or adapters may allow large sets of pages to be stored and then provide a browsing facility. The telesoftware capability on teletext and PRESTEL is being considered as both a method to update software and broadcast 'taster' versions of programs.

Undoubtedly the arrival of cable television and its implications for interactive television may well allow many PRESTEL like features to be available in CEEFAX and ORACLE. However, as educationalists, we are well aware that interaction always provides room for charging for the particular services used.

Details of Acorn's teletext adapter for the BBC computer can be obtained from Acorn Computer Group, Fulbourne Road, Cherry Hutton, Cambridge, CB1 4JN. Details of OEL's adapter and the Channel 4 teletext service from 4-tel, Channel Four, 60 Charlotte Street, London, W1P 2AX.

Electronic Mail

Electronic mail systems complement the normal postal delivery system. In an electronic mail system letters are dispatched and received over the telephone system. In general letters are prepared using a wordprocessor package on a computer, the computer is connected to the central electronic mail service through the telephone network and the letters lodged on the central computer. The recipient will be notified of any mail waiting to be read on linking in to the central computer.

The main advantages of electronic mail are instant dispatch and moving collection. Once a letter has been lodged it can be read; frequently anywhere in the world by making a local telephone call. The moving collection means that mail can be read anywhere, home, office or at any place where a computer can be linked into the central computer. Letters are protected from being read by other people by the use of an identification code and a password. The identification code is like a postal address and must be quoted to send (or lodge) letters, to read letters the code and correct password must be used. The equipment needed to gain access to an electronic mail service is the same as that used for PRESTEL and other telephone connect computer services, namely a computer, telephone, modem and appropriate software.

Frequently the central computer can be contacted through a locally charged call using the PSS (Packet Switched Service). This saves the cost of expensive long distance calls.

As stated earlier, electronic mail is designed to complement rather than replace the postal service. Naturally, a major restriction being that you can only contact those people who are members of the electronic mail service. Growing numbers of people and organisations are joining electronic mail services at present.

Electronic mail supports many of the facilities of a normal telephone call. However, it does not cause any interruption to the person being sent the letter, the social exchanges usually associated with telephone calls are excluded, the telephone connect time is usually shorter and hence cheaper, and you do not need to know where the recipient of your letter is. The usual operation of an electronic mail service is the preparation of the letter on a computer using a wordprocessor, dialling the electronic mail service, transferring the letter and disconnecting. This is frequently quicker and cheaper than other methods. However, many facilities additional to those associated with the postal service are also available.

(i) a letter can be sent to a large number of people just by adding their names to a list;
(ii) letters can be sent so that you are notified when they have been read;
(iii) letters can be sent in such a way that the reader is forced to reply as soon as they have read it;
(iv) letters received can be re-directed rapidly;
(v) carbon copies of letters can be kept on the system although this is expensive;
(vi) automatic spelling can be used;
(vii) the standard telex, telemessage and radio paging services can be accessed.

At present the most widely used electronic mail service is Telecom Gold. However, a recent initiative designed specifically for schools is The Time Network for Schools (TTNS). This provides the facilities of electronic mail together with those of an information service. The costs of joining this service are £69 per term, this covers all costs except telephone charges. Further details can be obtained from, TTNS, P.O. Box 7, 220 Grays Inn Road, London, WC1X 8EZ.

Electronic mail must have many uses in education where people are difficult to contact on the telephone and letters frequently are mailed to groups of people.

Summary

This article describes three particular information systems. All have educational aspects allied to their commercial and business usage. At present PRESTEL, CEEFAX and ORACLE are information systems we can draw upon. However, the merging of electronic mail facilities into information services has implications for schools as both providers and receivers of information.

Undoubtedly the costs of such systems are high particularly in the present economic climate. It is to be hoped that they will come down in the near future. However, many people feel we have already left the computer age and are now entering the age of information technology. There are tremendous opportunities for learning with such systems. Children are not constrained by the books in their libraries or local knowledge. Such information systems will allow children access to information from a wide range of sources. Much of it will require assistance from teachers in its interpretation.

If we can solve the problem of the high cost of using these systems then the potential of such systems to allow children to retrieve and share information is tremendous.

Footnote – electronic mail, teletext and viewdata systems will be available for evaluation at your local MEP Regional Information Centre.

A Videodisc Image Database for Classroom Use by Bill Plummer

The rapid spread of electronic media into the fields of the home and classroom has made the possibility of profitable electronic publishing a reality. Random access image databases containing both still and moving sequences open up an exciting prospect for all areas of education.

Up to November 1983 no serious attempt had been made to utilise the facilities of videodisc as an image database for use in the classroom.

A one-year secondment to Westhill College, Birmingham, provided the opportunity to design and create a textual and image database using a BBC Micro, a Pioneer optical disc player, an Acorn interface and the "BBC Videobook of Garden Birds".

Modern electronic based technology is, as a generalisation, concerned with the rapid and accurate communication of information be it digital, images, speech or text. This can be between machine and machine, machine and human, human and human. Without communication it is almost impossible for learning to take place whether it be at the most advanced or the most primitive level, whether it be aural, visual, tactile, nasal, verbalised or internalised. To this extent there seems little conflict between the functions of the electronic media and those of more traditional learning media.

However, in the past, applications of these new media have been able to provide only limited interactivity. Television programmes are designed as units of continuous narrative, display or demonstration. The viewer cannot pause, hold the programme whilst reflecting on its contents or adequately take notes without missing some subsequent part of the presentation nor can he/she question the system to clarify and test his or her understanding.

Video cassette recorders now offer opportunities for some interaction allowing the user to stop, slow down, or review a segment of a programme. Despite the opportunities offered by the ability to record and control educational television programmes, in a majority of schools the facility is used merely as a time-tabling convenience freeing the teacher from the constraints of television scheduling. In addition magnetic tape systems have some serious limitations, and better facilities are now becoming available through videodisc technology which permit a far greater degree of interactivity between the learner, teacher and the learning material.

There are two competing videodisc systems on the market at the present moment and, whereas videotape formats employ similar principles for both recording and playing back the video signals, each videodisc system uses its own technology for both recording and playing back the video signals.

The VHD disc holds 45,000 still frames and has a variable spin rate of either 750 rpm or 900 rpm so is able to cope with both the NTSC and PAL recording/playback formats. Two frames are recorded on each revolution and the disc has a linear playing time of two hours. The 10" disc is encased in a protective sheath that is automatically removed by the player on insertion. The presence of the protective sleeve indicates one of its drawbacks: it is sensitive to dust, scratches etc. Another is that its lifespan is indeterminate but the manufacturers now offer a replacement service which permits the purchase of new discs at a reduced price. The VHD system offers frame accurate random access, two audio tracks, quick and slow forward and reverse, and still frame. The still-frame facility however is of poor quality since there are two frames on each track and judder occurs as the system is reading two non identical frames. This can be overcome by recording two identical frames on the one track but this not only reduces playing time but also inhibits true interactivity since the choice of still frames must be made at the time of mastering the disc and cannot be altered either by the user, or the interactive courseware programmer.

THE OPTICAL DISC is a system which uses a laser beam both to record and read the information encoded well below a protective plastic coating on the surface of the disc. These discs can be used to encode any kind of information through the use of digital storage techniques. Included amongst this information are sound, text, still and moving images. Discs which are dedicated to this media are known generically as Reflective Optical Discs, and commercially as Laservision Discs. Most libraries, bookshops and archival requirements in the commercial field at present use microfiche techniques for storage but increasingly videodiscs are entering the field using recordable disc technology. For example the French Military archives, the National Library of Congress and many Public and Academic Archives are amongst intending users. In addition commercial cable information services are also using the technology of the video disc. The reason for this interest is that ANY frame can be held as a still for any length of time with no deterioration in quality.

There are two varieties of reflective optical discs, these are known as Constant Linear Velocity (CLV) and Constant Angular Velocity (CAV or Active Play):

a) CLV discs are used for feature films and linear presentations. These have a fixed length of track for each frame. Obviously the length of the external tracks is greater than the central tracks and more frames can be recorded on them. This permits a total of 87,000 frames per side or two hours playing time per double sided disc. Fast and slow forward and reverse play is available but frame access must be based on time and is not accurate.

b) CAV discs replay their images at the rate of one per revolution. At the rate of the disc this means that 15,000 frames can be presented every minute in linear play. Each disc can offer about 30 minutes continuous play per side. The track length of each frame is not fixed but instead occupies the whole length of one revolution irrespective of its length of track. This means that any frame can be found quickly, directly and accurately within seconds. Having been called up the picture is of superb quality since only one frame is recorded on each track/revolution. The picture can be held for an indefinite length of time with no loss of quality. The fact that accurate access to any part of the disc is possible the actual playing time can be of any duration in an interactive computer controlled system. CAV discs normally have frame numbers associated with each frame which can be displayed by means of a hand held controller or under computer control. It is both the quality of the pictures (whether moving, slow motion or still), the speed of particular frame access (between 4 and 10 secs), the random access facility and the durability of the medium which offer the teacher and programmer the possibility of a whole new resource in the education of young children.

For most hard-pressed established classroom teachers the main, and perhaps only, criteria for justifying the introduction of new resources, curricula, technology or methods can be established by answering the following questions:

1. Does it enhance the quality of the existing learning material the teacher is able to offer the students?
2. Does it reduce the amount of time the teacher must spend on non teaching adminstrative tasks yet improve or at least maintain the efficiency of existing administrative methods?
3. Does the acquisition of new skills, for educational, social or vocational exigencies, alone justify the change and resource commitment?
4. Is its use restricted to a few areas of the curriculum or applicable to all disciplines?

Whilst confirming that microelectronics technology could justify its place in the classroom, experience in programming full screen graphics indicated that the resulting images were, at present, stylised and symplistic and therefore unsuitable for many learning situations where natural movement, accuracy and realism are desirable. This led me to an investigation of the possibilities of incorporating video sequences into computer generated learning material. This investigation spawned the final project, undertaken whilst on a year's secondment to Westhill College, Birmingham.

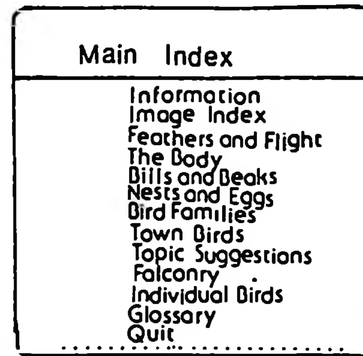
An analysis of the use and suitability of existing classroom resources led to the following conclusions:

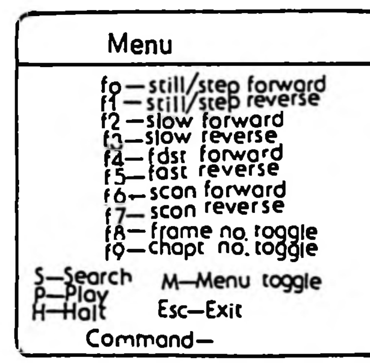
1. The eventual package should be one that could be applied to a common acceptable classroom work pattern and integrated with existing resources so that the teacher/user would not need to devise a whole new classroom organisation.
2. It should at all times offer maximum flexibility and choice to the teacher and user so that movement between various program components can be made freely and quickly.
3. The final programmed package should be comprehensive, offering both teacher and user general support, evaluation and child response storage facilities, and guidance on use (documentation).
4. It should attempt to satisfy the requirements of three common classroom strategies:
   a) Teacher centred class teaching with active pupil participation.
   b) Self-motivated pupil centred study.
   c) Structured pupil centred but teacher guided study.
5. The package should contain enough material to be viable as a resource for a class project ie. 30-35 pupils.

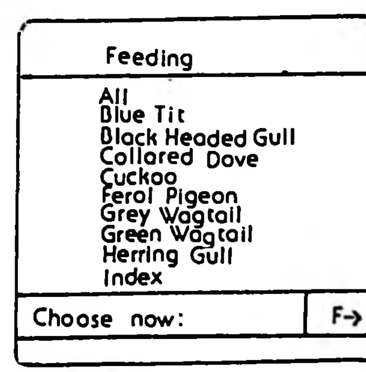
Having established these criteria the design of the package then presented new problems not least of which was sheer size. Having 'obtained' the necessary equipment, by traditional Primary teacher means, I then chose to base the project on the "BBC Video Book of Garden Birds" being one of the few commercially available Videodiscs containing suitable Educational material. This disc contains around 100,000 bird images and covers the behaviour, habitat and distribution of some 42 birds. The package finally occupied some 400K of disc memory.

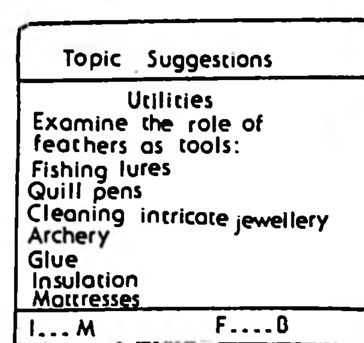
The language I used to write the program was Microtext. I decided to attempt only one side of the disc, that is 28 birds.

It is very difficult to explain the power of control of the visual medium, provided by Interactive Videodisc Technology, in words, but an indication of the facilities eventually provided by the project can be obtained from Figs 1-4.









The package itself took over 600 hours to create, not including design "thinking" time. Obviously this time scale is prohibitive to ordinary classroom teachers; yet each teacher's circumstances, age group, ability range, and subject knowledge is different so some means must be found to enable them to "tailor" the package to individual circumstances.

In actual classroom use I have found 10 year old children fully capable of using the package although the study units are too long and no provision has been made for returning to a particular point in the module after a period of rest. I am convinced that the concepts behind the package are sound but, in the light of experience, I would totally alter the structure of the package if attempting the same project again. I would add the caveat that I fully recognise the dangers of the author of a program also acting as evaluator.

Developments in electronic publishing and delivery systems are being announced almost daily. Digital data transfer, optical fibre technology, on-line data systems, digital images, cable and satellite broadcasting are all bringing the possibility of home-based learning systems nearer. The need for a workforce able to retrain repeatedly as technology produces new manufacturing processes, concepts and skills will become paramount. Human, organizational and financial limits establish plateaux for retraining and education which are very difficult to expand swiftly enough to respond to changing commercial needs using traditional educational methods. The demand for skill training and continuing education, for leisure and career purposes, will increase as the demographical and labour structures of the population fluctuate.

Since the necessary technology exists, albeit still developing, the pressures of demand will ensure that home education systems will be developed by publishing and private education institutions. Various cable and telephone franchise holders are already devising and developing home-based encyclopedia and interactive education programs, for both home and school, using videodisc and computer technologies. It is important both for the quality of the commercial material eventually produced and for the quality of the school learning environment, that experienced, practicising teachers become involved in these developments so that the experiences of early programmed computer based material is not repeated. In addition recordable videodiscs machines, already developed in prototype form, and digital image microprocessors able to store images for random access will become generally available possibly within two or three years. This will bring the possibility of the provision of county or nationally based image databases and resources covering the whole curriculum as well as teacher and staff training closer to reality.

Research into program design and control systems using existing school technology is needed if we are to build a professional consensus of opinion of what classroom teachers need from an extremely powerful communications and learning medium. The B.B.C. Domesday project is an indication of the resource commitment needed for a national project in this field and it will be in itself a great logistical and technical achievement. But its value as a teaching aid, integrated into the classroom and the general curriculum needs to be examined extremely carefully. Publishers will need to be encouraged to follow up the project with additional material both related and unrelated. Schools will need funding to enable them to access the material.

Software will need to be created that enables teachers, perhaps technically weak but pedagogically strong, to use the image and textual material according to their own circumstances and professional judgement. Such software will need to take into account a wide range of alternative input devices such as touch screens, voice control, light pens, concept keyboards, joysticks etc., It will need to provide nested layers of textual information to cater for a variety of ability ranges and monitor the student's progress and response. Support material should be integral to the design both for student, teacher or trainer.

The widespread introduction of Interactive video systems with a comprehensive range of Videodiscs into Primary schools would offer the teacher and student a new or improved range of learning stimuli stretching across the whole curriculum. It provides both teacher and pupil with a shared experience of events both natural and social and permitting their examination in whatever sequence, speed or detail the observers require. Many common experiences happening at natural speed, such as sporting events, animal behaviour, natural phenomena etc., occur too fast for all their implications to be discussed, studied or even observed. The Videodisc technology permits any recorded sequence to be displayed at any speed, momentary events held and instant comparisons made between similar events or objects. It permits the teacher to focus the pupil's attention on particular areas of moving sequences to observe the environment or behaviour associated with the main event of the sequence. Its curricular spread ranges from applied mathematical structures, such as bridges, and conceptual experiences, such as transformations and sets, to language development based on a common repeatable experience, to environmental studies and comparisons, to social events for behavioural, moral or religious analysis, to sporting techniques, to science activities and wildlife studies and so on.

In none of these areas does videodisc technology provide the complete answer or undermine the philosophical base of primary education but what it does do is enrich the stimuli available to both teacher and pupil to such an extent that it is tantamount to removing the enclosed environment of the school and classroom and enabling the teacher to walk freely with his or her pupils through areas of the community and environment previously inaccessible.

Information technology is unlikely to be able to ever become a substitute for the sensory and tactile experience of natural physical events but it can offer some facilities not present in nature, for example natural experiences are often transitory, fast and unrepeatable, technology can provide these facilities. It will be some while before such facilities become available to all teachers but come they will and when they do they will become as essential as books are today.

MEP National Primary Project

January – December 1984

by Christine Robson

Information Officer, MEP National Primary Project.

In PRIMARY CONTACT'S Special Issue Number 2 on Microcomputers, Philip Fisher outlined the aims of the MEP National Primary Project and suggested some of the ways in which we hoped to achieve these. In this article I hope to give readers some idea of our progress to date.

The task of providing support for teachers in the 27,000 primary schools in England, Wales and Northern Ireland is a massive one, and the Project was asked to direct its efforts towards those responsible for the in-service and pre-service training of primary teachers.

In order to form a national picture of these needs, the first phase of the project involved members of the team in widespread consultations, which included visits to all 14 of the MEP regions.

It became apparent that our courses would need a flexible structure to accommodate the needs of different groups. First, primary advisers and lecturers in primary education need some assistance in learning about equipment and different types of software. For them, placing the software in the context of good primary practice is not difficult. On the other hand, computing advisers and lecturers tend to come from a secondary school background, and whilst their technical knowledge is a great help to us all, their knowledge of, for example pre-literacy skills, may not be so well developed! In between these two groups falls another: primary teachers of considerable experience who have acquired the necessary technical competence, and are now helping other colleagues, perhaps in the role of an advisory teacher.

In-service training packs

To help on these courses we have planned a series of in-service training packs to be distributed free to all LEAs and teacher training institutions. The packs will include course outlines, slides, audio tapes, overhead transparencies and software which can be used by advisers and trainers running their own courses, and freely copied for use by those teachers attending the courses.

Packs produced so far have been "The Mary Rose", "Primary Maths and Micros", "Language Development in the Primary School" which included a video "Talking Point", and the "Micros in Project Work" pack, edited by Jan Stewart.

Another pack, "Microelectronics Education in Initial Primary Training" was distributed to teacher training institutions. Four case studies and a series of taped interviews outlined the introduction of microelectronics training in four teacher training institutions. The participants hoped that the accounts of the pitfalls and possibilities they encountered would help others treading the same path and act as a stimulus for discussion.

Four more packs are planned: one for infant/first schools and three around the theme "Problem Posing and Problem Solving".

Included in the infant/first school pack will be slides, an audio tape, examples of children's work, course notes, a disc of software and a collection of articles. There will also be a catalogue of software and details of other available resources.

The first of the Problem Solving packs will be based on LOGO activities. The contents will include a booklet by Richard Noss comparing various LOGOs, a comparison of Turtle graphics packages by Berkshire teachers and a book of case studies compiled and edited by Beverly Anderson. The software will include four "Microworlds" written in LOGO by Mike Sharples and Helen Finlayson.

The second Problem Solving pack is being prepared by Heather Govier, MEP Primary Co-ordinator for Capital Region. This will include at least three of the programs being developed by the Croydon Problem Solving Project, together with articles and other materials.

In a joint MEP/BST (British School Technology) venture Roy Richardson is developing technology/control technology materials for the third of these packs. Included in this will be a video covering the introduction of control technology to a group of teachers and their introduction of it into their classrooms. Videos of classroom activities are also planned for the other two Problem Solving packs.

This term has also seen the publication of "Teachers Learning" by Joan Dean, Chief Inspector of Surrey. We hope that this handbook will not only help the increasing number of teachers being seconded to assist on courses in microtechnology at the primary level, but also act as an aide-memoire to more experienced teacher trainers.

The primary software catalogue

A fully updated version of the primary software catalogue was issued to all LEAs and teacher training institutions in September; this can also be obtained as a QUESTD file (on an 80-track disc only) for BBC, or for RML machines. As the catalogue now contains some 650 entries and is increasing almost daily, it is unlikely that there will be another printed edition of the full catalogue, although we hope to publish smaller catalogues, perhaps for specific interest groups like infant teachers or Spectrum users.

In January 1984 an HMI/MEP invitation conference was held at Elcott Park, with the purpose of producing some guidelines for curriculum development and in-service training at the primary level. Each of the eight discussion groups produced a paper. The task of editing these is now complete. They will be published early in 1985 and distributed through our normal channels.

Courses

In the Summer term of 1984 we ran a total of six courses for both primary advisers/lecturers and computing advisers. The first group had a general introduction to computer use in schools with hands-on work using the Language pack and Maths pack software and additional optional sessions on information retrieval and Turtle graphics. Computing personnel had an introduction to good primary school practice given by John Coe (chairman of NAPE) with sessions on current thinking about language, maths and technology in primary schools.

This term we have held three one-week courses for people with both primary and computing experience at Newman College in Birmingham. The theme of these courses has been project work in the primary schools, and has been largely based on the materials in our Project Work Pack. We are grateful to all the people who have assisted us on our courses, particularly Roger Keeling and Senga Whiteman from Newman College, and Jan Stewart and Jon Coupland from ITMA who have played a major part in both the planning and running of these courses.

With the help of the Newman College team we also held a one week residential course for the newly appointed MEP Regional Primary Co-ordinators. Their role will be to help disseminate the project's materials within the MEP regions and feed back information about local activities and requirements.

Our 1985/86 courses will include two more on project work, two "Introductory" ones for primary advisers/ lecturers, and courses to support the LOGO and Control Technology packs.

Unfortunately, considerations of both finance and person-power have led us to restrict the number of our courses to three per term and we apologise to all those whose applications were unsuccessful. We have tried however to allocate places to as large a number of LEAs and HE establishments as we can and hope that the resultant 'cascade' will soak as many people as possible!

The micro's true potential

A valuable part of all our courses (and I suspect of anyone else's) has been the exchange of ideas between people from different areas and LEAs. Many teachers, having surmounted the technical problems of what to plug into where, are beginning to ask "What comes next?" With strict financial resources and limited time in which to browse the ever increasing number of programs, there has been an unprecedented demand for in-service support. Whilst no-one is expecting the needs to be met overnight, we hope that we have contributed, and will continue to provide some useful resources with which to tackle the problem. It has been encouraging to find that despite the variety of backgrounds of those concerned in in-service training, there is a consensus of opinion that whilst the micro is a powerful and versatile tool, its true potential is as a resource which can be called on to extend and develop good primary school practice.

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Durham
Co. Durham

North and West Yorks

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MUSE

MUSE is a national organisation which exists to help all those involved in education to make effective use of small computer systems in the promotion of learning. It has been in existence for ten years, but within the last four years the need for an organisation such as MUSE has become more apparent. The advent of the microcomputer in all schools and in the home has meant that more people require advice, practical help and training in the best way of using micros effectively and imaginatively in education. Membership is thus open to anyone, parents, teachers, students and institutions, and costs £15 per annum.

MUSE does not seek to compete with the various agencies set up by the government such as MEP, but rather to complement their work. This is done in many ways. Impartial advice and information on all aspects of hardware, add-ons and software are provided through the magazine "Computers in Schools", which is published four times a year, and the MUSE Reports which are published twice yearly. The Reports provide an opportunity for a particular area of interest, such as "Microcomputers in Primary Schools" (Report no. 5), to be tackled in greater depth.

MUSE also has an extensive catalogue of educational software, suitable for home as well as school use. Each program has been assessed for educational validity and accuracy before inclusion in the catologue. There are now well over fifty programs suitable for primary children. The cost of the software is kept as low as possible for members.

Each year MUSE holds a conference. This year it is at Nottingham University from 29th-31st July 1985. As the use of microcomputers in schools becomes less the prerogative of the specialist, so the role of the conference is changing to suit the needs of the non-technical classroom teacher. There will be less emphasis on computer studies and programming, although these aspects will still be covered, and more on practical help and advice in such areas as primary teaching, network management and the use of word processing as a tool for the teacher. The latest in hardware and software will also be on show. The organisation of the conference will enable the delegate to select a package of lectures to his own particular requirements. Other courses are arranged in conjunction with educational institutions.

In addition MUSE arranges insurance for members' equipment and publishes booklets and leaflets covering specialised learning material and valuable information.

MUSE is run by a committee elected by the membership. All are involved in some aspect of education either as teachers, lecturers or advisory teachers. They are helped by an office staff, headed by Mrs. Caroline Schadla-Hall, to whom any enquiries should be addressed in the first instance. The address is MUSE, P.O. BOX 43, HULL, HU1 2HD.

MUSE is a professional organisation, run for the benefit of teachers, parents and children. To continue to help our members MUSE welcomes information, articles, reviews for publication in our magazine and also welcomes suggestions for ways in which we can improve or enhance our services.

M.A.P.E.
(Micros and Primary Education)

M.A.P.E. is a national organisation which was established in 1981 with the support of the government agencies of M.E.P., C.E.T., and the D.T.I. It also enjoys the support of B.P. and I.B.M. among other industrial concerns. M.A.P.E. aims to:–

Promote and develop the awareness and effective use of microcomputers as an integral part of the philosophy and practice of Primary Education.

The organisation offers a substantial variety of services to its members.

A members' magazine called 'Microscope' is published three times a year. It contains articles which cover a wide range of interests such as, new computer developments, classroom case studies, general information and guidance, software and book reviews, personal views and stories, and items from experts in specific computer areas.

Members are also supplied with 'special' editions of Microscope. The content for these is chosen according to members' requests, and last year there were two publications on 'Logo' and 'Information Handling'.

For the last two years M.A.P.E. has issued software packages to all its members. Cassettes containing six programs were produced each year. This service was enthusiastically received.

An important part of M.A.P.E.'s support to members is through its many regional activities. There are fourteen regional bases throughout England, Scotland, Wales and Ireland. Each region has a representative who attends the National Committee meetings and can present the views and opinions of regional members. The role of the representative is also to provide a personal point of contact for members, and give any necessary help and advice. Many regions also hold workshops, conferences, and computer exhibitions etc. to meet local needs and requests.

An insurance discount service exists for members, and it is hoped that in the future discounts on software and hardware will also be available.

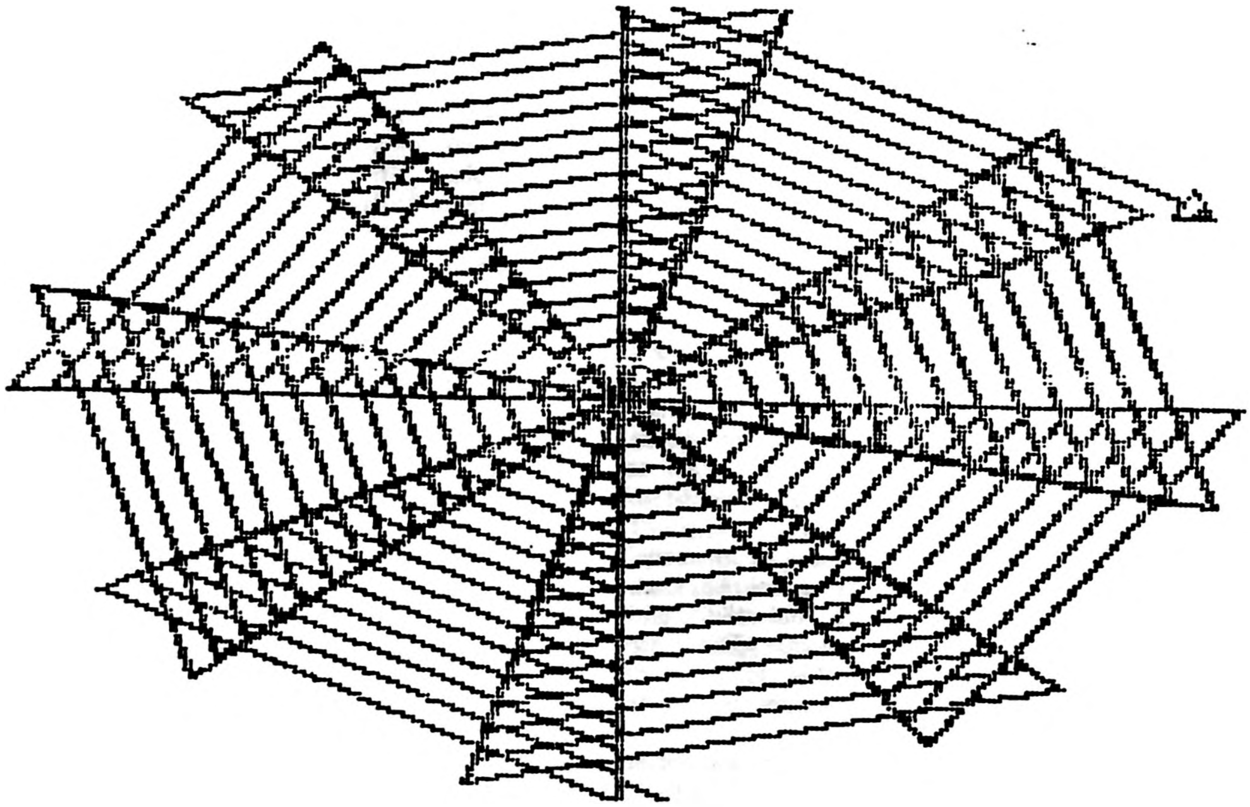
M.A.P.E. holds an annual Conference which is planned to suit a range of expertise and interests, and is always extremely successful.

Membership is open to any person or establishment having an interest in the primary sector of the Education Service. The fee is £10.00 and membership runs for 12 months from the date of registration. Application forms can be obtained from:–

M.A.P.E. Administration,
76, Sudbrooke Holme Drive, Sudbrooke, Lincs. LN2 2SF

Further information regarding M.A.P.E. general and regional activities can be obtained from:–

Mrs. A. Liddle,
M.A.P.E. Secretary,
Pentland Primary School, Pentland Avenue, Billingham, Cleveland. TS23 2RG.



British LOGO User Group (BLUG)

The Group was formed in late 1982 to promote the use of LOGO as a thinking tool. The Group is open to anyone with an interest in the use of LOGO. Our membership reflects many of the different facets of LOGO. Teachers are attracted to LOGO because of the potency of the learning environment offered by LOGO, and the attractions of the philosophy which underlies it. Computer scientists see the LOGO language as embodying good programming features. Psychologists view the human/machine interface as a fertile area of research. People from commercial and industrial backgrounds are aware of LOGO's potential for assisting in problem-solving by simulation and its inherent advantages as a medium for controlling processes and machines. The computer industry has acknowledged LOGO's importance by ensuring that LOGO is available for all of the most recently developed machines (many indigenous manufacturers have joined and supported BLUG). The membership of BLUG currently stands at just under 600, of which about 20% is from outside the United Kingdom.

The prime function of BLUG is one of communication. A quarterly newsletter, "Logos", is available free to members. Another annual publication "The LOGO Almanack", is about to make its appearance. A conference is held each year, at which it is possible to learn of the latest developments in the world of LOGO. BLUG is also evolving a regional structure, so that members will not find LOGO events too far removed from their home locality. The Group is an "open group" in that members receive, from time to time, a list of the membership to encourage and make possible informal member to member communication. It is hoped in the not too distant future to offer some bulletin board facilities for members. It is also hoped that there may be some occasional publications about aspects of LOGO.

Membership costs £10 per annum for individuals and £15 for institutions (institutional membership effectively offers two of everything). Information about BLUG can be obtained from:

Richard Olney,
BLUG,
London New Technology Network,
86-100 St Pancras Way,
LONDON NW1 9ES

The next BLUG Conference is being held from 30th August to 1st September in Glasgow. Details can be obtained from:

The ~~In~~-Service Department,
St Andrews College of Education,
Bearsden,
GLASGOW G61 4QA.

GREATER MANCHESTER PRIMARY CONTACT

Ordinary Issues

Publication will be three times yearly, Spring, Summer and Winter. These three issues will constitute a volume.

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Order and subscriptions must be accompanied by payment and sent to the address below. **Cheques should be made out to Manchester City Council.**

Special Issues

Special Issue Number 3, "Microcomputers" (1985) is a completely new issue that follows the success of the earlier issue of the same title published in 1983.

Special Issue Number 3, "Microcomputers" (1985) can be ordered at a total cost of £5 inclusive of postage and packing. If sold by hand, the issue will cost £4.

Special Issue Number 4, "Environmental Studies and the Primary School" can also now be ordered at a cost of £3.25 inclusive of p.&p.

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Please address all orders to Roland Fairbrother, The Editor, (G.M.P.C.), Didsbury School of Education, Manchester Polytechnic, 799 Wilmslow Road, Didsbury, Manchester M20 8RR.

Overseas rates

3 issues of Vol. 3: USA, $9; Europe, £7. Special Issue No. 3 "Microcomputers" (1985): USA, $10; Europe, £8. Special Issue No. 4 "Environmental Studies and the Primary School": USA £7; Europe, £5.

Contributors

Articles, information and news will be welcomed from lecturers, teachers and all others concerned with some aspect of primary education.

All correspondence

Articles, advertisements, orders and subscriptions should be addressed to The Editor at the above address.

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