MICRO-SCOPE

SPECIAL AUTUMN 89

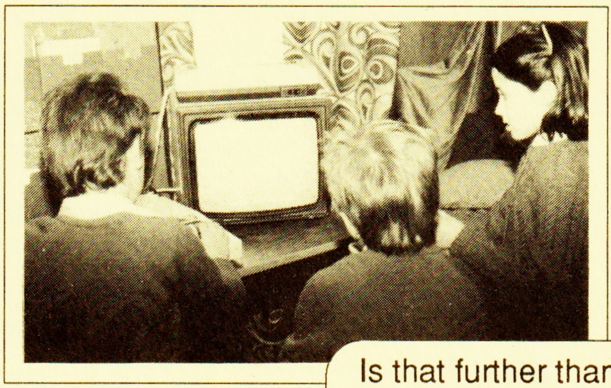
Primary Science: The role of Information Technology

Experimenting

How far can you jump?

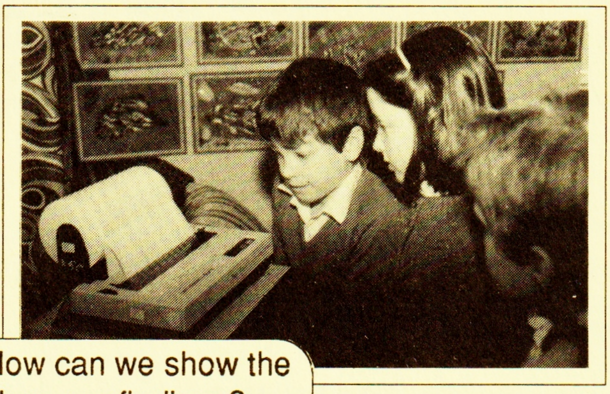
Was it a fair test?

Recording



Is that further than I did yesterday?

Drawing conclusions



How can we show the class our findings?

NCET NEWMAN COLLEGE WITH MAPE

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Editorial

This MAPE Special represents a welcome collaboration between MAPE and NCET at a time when the role of Information Technology in the Primary Science Curriculum is an important issue. We hope that the articles and case studies in this booklet will help teachers to identify those uses of I.T. which will best support their teaching of science.

This booklet has been produced by the NCET Primary Science Advisory Team which is a group of educators all having a background in primary teaching with a particular interest in science.

The group was originally brought together under MESU to produce "Data Handling in Primary Science", a package of materials showing how primary science activities could be supported and enhanced through the use of data handling programs. We are grateful to MAPE for the opportunity to share our experience of how other aspects of I.T. can similarly be of value in primary science activities.

Keith Hemsley   August '89

Software

The 'flippy' disc which accompanies this Micro-Scope Special contains a data-logging program, ESP, on one side and a number of files on the other side.

ESP

ESP is a BBC Computer program which allows children to become involved in data-logging at a basic level using a simple analogue interface. The documentation for ESP can be found at the back of this booklet (pages 34 - 36). We are aware that few teachers, at present, have access to data-logging hardware but feel that there is a growing interest in this application I.T. which merits the inclusion of ESP in this issue.

Those teachers who would like to try data-logging might be able to borrow an interface and sensors from their teachers' centre. Alternatively we have arranged for Deltronics Ltd to produce two introductory data-logging kits.

Kit 1 consists of a temperature sensor and light sensor wired into a D-plug which fits directly into the BBC's analogue port.

Kit 2 has two temperature sensors. Both are available from:

Dai Lloyd Deltronics
Heol-y-Parc, Cefneithin,
Llanelli,
Dyfed.
SA14 7DL   Tel 0269 843728

Kit 1 costs £14.95, Kit 2 costs £17.95 inclusive of VAT and postage and packing.

The flip side of the disc contains a number of Concept Keyboard overlay files and a set of LOGO procedures.

The Concept Keyboard files support three of Ann Orchard's overlays which are reproduced on the back of the centre pull-out and the back cover of this issue.

Instructions for creating working discs for use with SORTING GAME are included on the disc.

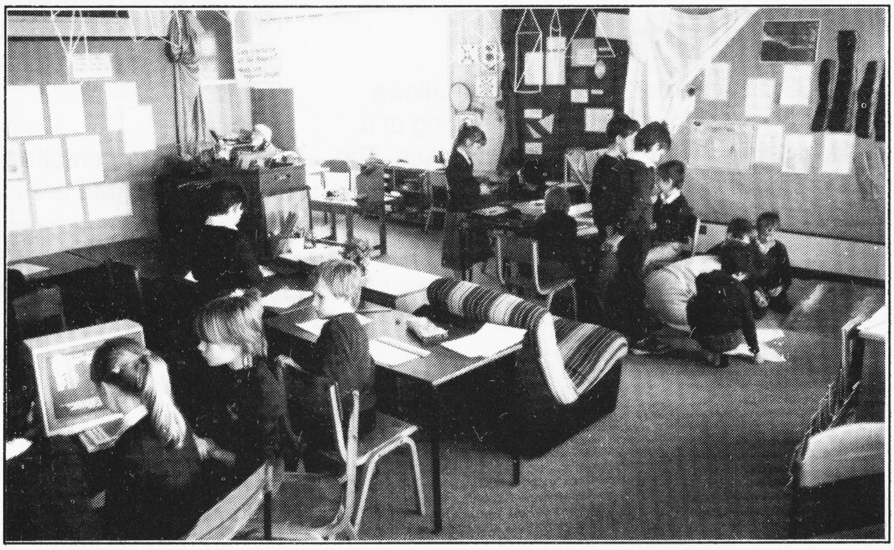
The LOGO files are those referred to in John Lodge's article on Measuring with LOGO.

Using InformationTechnology to support Primary Science: a rationale

John Wilson, Senior Lecturer in Curriculum Studies, Primary Science and Technology, Leeds Polytechnic.

Some time ago I asked a headteacher if he would be willing for any of his staff to trial some data-handling software. While he was happy for me to see the science in the school he freely admitted that his staff had not really come to grips with good practice in I.T. I was taken to a classroom where some excellent primary science was in progress. Children were working cooperatively and enthusiastically in groups following investigations of their own design. There were several three-dimensional displays of past work as well as collections of materials to stimulate the current topic. Written work was of a high standard and well displayed.

What left the biggest impression was the sheer volume of results from the children's investigations. The room was bursting with displays of hand-drawn materials. With such a wealth of data there was little chance that they could interpret and exploit their hard-won findings to maximum potential. Here was a class that was ready to use the power of Information Technology to enhance their good practice.



There is generally broad agreement about what constitutes good practice in primary science, identified by observations of a class or group of children in action. First and foremost the children will be involved in first-hand experience, largely or partly inspired by their own questioning. Children and teacher will be communicating in an atmosphere of mutual respect, rethinking and modifying their ideas in the light of new experiences. As data is interpreted the class will make informed choices and decisions about further investigations.

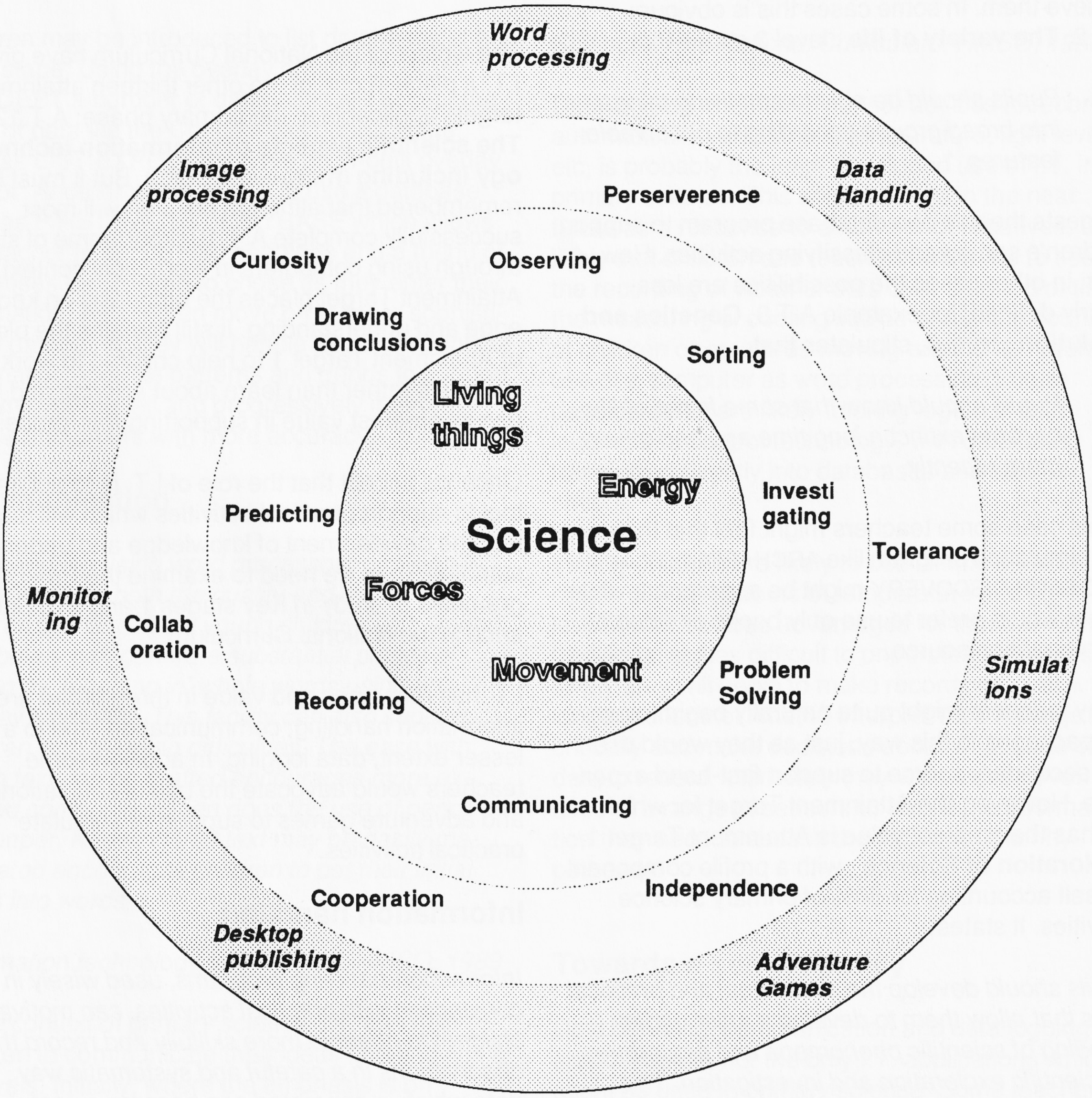
This booklet aims to show that this classroom process, through which good primary science develops, can be supported and enhanced by the effective and appropriate use of I.T. Collaborative experiences can be developed, not only through the shared production of word-processed text but in the processes of constructing a database or participating in practical work as part of a simulation or adventure game.

The freedom to redraft text and data without totally rewriting is a powerful encouragement for children to rethink and modify their ideas. I.T. gives speed, variety and flexibility to the displaying of data. Not only does this enhance communication, it also extends the possibilities of interpretation and pattern seeking.

Not all software will directly enhance or support good practice. Some, notably simulations and adventure games, will serve to stimulate first-hand investigations.

One feature of good science is that children have learnt to make appropriate use of equipment and draw on other available resources in pursuit of their investigations. There is every reason why this should include software. The ideal school policy is one where children not only have free access to a selection of software but are encouraged to develop the skills and confidence to make independent appropriate use of I.T.

An overview of the inter-related elements of Primary Science and Information Technology



Using Information Technology to support primary science in the National Curriculum

Keith Hemsley, Curriculum Officer, National Council for Educational Technology

It is tempting to approach the task of identifying how I.T. might support primary science in the National Curriculum by concentrating on specific statements of attainment and trying to identify specific computer programs which might help to achieve them. In some cases this is obvious: A.T.2, **The variety of life** : level 3 states that

> *Pupils should be able to sort living things into broad groups according to observable features. '*

suggests the use of a database program to support children's sorting and classifying activities. However, in other cases the possibilities are less clearly defined: for example A.T.3, **Genetics and Evolution** : level 3, stipulates that

> *Pupils should know that some forms of life became extinct a long time ago and others more recently.*

In this case some teachers might feel that the use of a simulation program like ARCHAEOLOGY or DINOSAUR DISCOVERY might be appropriate while others would prefer to use only books or video as an information source.

Many teachers might quite naturally begin to use I.T. packages in this way, just as they would use any secondary source to support first-hand experience. However, the Attainment Target for which I.T. has the greatest value is Attainment Target 1, **Exploration of Science** , with a profile component to itself accounting for 50% of primary science activities. It states:

Pupils should develop the intellectual and practical skills that allow them to develop a fuller understanding of scientific phenomena and procedures of scientific exploration and investigation. This work should take place in the context of activities that require a progressively more systematic and quantified approach, which draws upon an increasing knowledge and understanding of science. The activities should encourage the ability to:

i. plan, hypothesise and predict

ii. design and carry out investigations

iii. interpret results and findings

iv. draw inferences

v. communicate exploratory tasks and experiments.

Science in the National Curriculum HMSO, 1989

The writers of the National Curriculum have given I.T. a place in one of the other thirteen attainment targets applicable to the primary phase: A.T.12: **The scientific aspects of information technology including microelectronics**. But it must be remembered that although children will most successfully complete A.T.12 programme of study through using computers in a practical context, this Attainment Target places the emphasis on knowledge and understanding. It still remains the place of Attainment Target 1 to help children to work as scientists rather than learn about science and I.T. has its greatest value in supporting *this* process.

Once we accept that the role of I.T. is to act as a tool to support practical activities which will facilitate the development of knowledge and understanding, then we need to examine the Programmes of study in Key stages 1 and 2 of Science in the National Curriculum.

I.T .has relevance and value in three broad areas: information handling, communication, and to a lesser extent, data logging. In addition some teachers would advocate the use of simulations and adventure games to support or stimulate practical activities.

Information handling

Information-handling programs, used wisely in conjunction with practical activities, can motivate children to observe more skilfully and record their observations in a careful and systematic way. The data which is generated can become a useful resource which may be consulted, reorganised or extended to stimulate further investigations. Far from being a solitary activity, the kind of work that the computer fosters encourages children to discuss and communicate their findings more willingly.

Data Handling in Primary Science, MESU, 1988

Information handling is readily applicable to science at all levels. Early sorting activities encourage children to look at differences between objects and lead to sorting and grouping (classifying) according to observed criteria. The use of a simple branching database can enhance and extend these activities in addition to providing a vehicle for recording and communicating their observations. Simple graph-drawing programs such as DATA COLLECTOR, which uses the concept keyboard as a data entry system, DATASHOW or DISPLAY DATA will allow bar- and pie-charts to be drawn quickly and easily from children's own observations.

Children may be introduced to list databases at an early stage. Using the overlay creator program CONCEPT a number of databases will accept the entry of data via the Concept Keyboard, some such as LIST EXPLORER have an in-built overlay creator. Another alternative is to use a database such as FIRST FACTS or DIYBASE which allows the teacher to set up field headings and a menu of responses for children to chose as they enter their information. As children move on to more sophisticated databases they will handle larger amounts of information, look for patterns and trends to support or form hypotheses and progressively interpret graphs and charts with more accuracy.

Communication

Text handling using word processors can significantly improve both the quality and quantity of children's writing. Very young children with limited vocabulary can generate substantial pieces of writing by 'touching in' whole words using an overlay keyboard. This facility can also support children with learning difficulties. The ease with which text can be drafted encourages more extended composition then does the use of pencil and paper. Knowing that text may be easily manipulated encourages children to put their initial ideas into words.

Information technology from 5 to 16, HMSO, 1989

In the context of primary science, I.T. can help children to communicate their ideas and findings at all levels. Initially, where the emphasis is on children talking about their observations, a Concept Keyboard is an ideal way to translate their own language into a word-processor or simple database . As their facility with a simple word processor develops they will tend to make greater use of the QWERTY keyboard and begin to use editing facilities to improve and restructure their writing. Increasingly children will want to use tables, charts and graphs, which may be an output from a database or spreadsheet, to communicate their findings. Ultimately they may have access to desk-top publishing facilities, to bring all these elements together.

Data logging

(Children should be encouraged to develop their investigative skills and their understanding of science in activities which)....develop skills of using equipment and measurement, encouraging children to make decisions about when, what and how to measure.

Science in the National Curriculum, HMSO, 1989

Data logging, the use of sensor devices to record automatically variations in temperature, light levels etc, is probably the least developed use of I.T. in primary science. This could change in the near future as a response to a number of initiatives. It is likely that children and teachers will come to see the recording of weather data over a period of time, the measuring of cooling liquids or making counts of children or creatures moving around as natural a use of a computer as word processing. Future developments are likely to bring together data-logging and control technology, with data being transferred directly into databases and spreadsheets.

Initially children are likely to use simple sensors to obtain digital readouts of temperature and light levels; with obvious advantages for those who find traditional scales difficult to understand. Progressively they will begin to make recordings over longer periods of time, to interpret their findings critically and make decisions about what sorts of data to record. Ultimately they will devise novel uses of a range of sensors to obtain the information they need to assess the validity of their hypotheses.

Towards a school policy

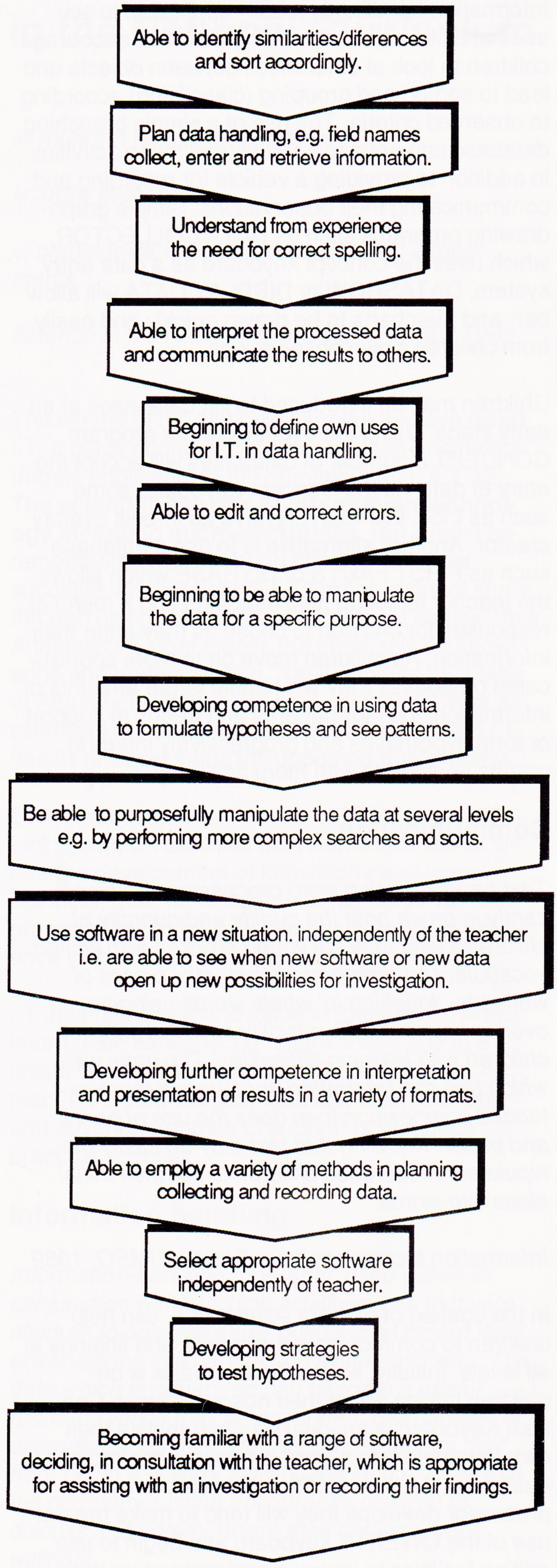
Data handling, communication and data logging are, of course, not the only I.T. applications which might be used in primary science. Some teachers would argue strongly that spreadsheets and adventure games are a must. However, many schools are having to come to terms with I.T. at key stage 1 in the core subjects of the National Curriculum for the first time. For them two major applications, data handling and word processing, are more than enough to deal with. They will need to consider what packages and peripherals need to be available to ensure children's knowledge and understanding of I.T. is developed through purposeful use.

Progression.....means not that pupils necessarily use more sophisticated I.T. tools but that they apply such techniques as they have mastered to progressively more difficult problems through their curricular studies, or use them to extend their work in terms of quality, quantity or both.

Information Technology from 5 - 16, HMSO, 1989

It is the task of the individual school, with informed advice, to decide how I.T. will be used to support the curriculum. Each will have to take into account not only which computer packages to use but also the implications for resourcing and staff development.

Central to the development of a school policy in any curriculum area is the child. If we are to bring progression and continuity into our planning we need to carefully consider the capabilities and developmental processes involved in the child's aquisition of understanding, skills and attitudes. The diagram opposite looks at progression in developing I.T. skills in Data Handling as they have been observed by a number of primary teachers with a particular interest in both science and I.T. Of course not all children will progress at the same rate through all the stages.



Supporting Primary Science with Data Handling programs

In both the following case studies all the activities are based on first-hand experience which is central to primary science. What is important, is that children are engaged in good science; exploring and investigating in a relevant context. The computer aids this process.

The use of appropriate software develops observational skills in different ways; it also gives a medium for children to describe and communicate their observations easily and effectively. Children ask questions and pursue inquiries and the computer leads to an enhancement of this process, in the structure of the program itself, or the organisation of the children's own data. Attitudes of independence and cooperation, obviously already encouraged by the teachers, are further extended through this use of I.T.

1. Observing, Sorting and Classifying

Ann Orchard, Advisory Teacher for Primary Science, Avon
(This article was written prior to Ann taking up her present post)

St Andrew's Infant School in Clevedon, near Bristol, has five classes on a split site. We work in mobile classrooms, have no corridors, very few communal areas, and no hall. However, we do have more than average staffing, and I am fortunate in having a class of 22 children. I work with 2nd- and 3rd-year Infants.

We have two computers between five classes and, generally, the staff have opted for a two-week spell each. This is flexible and everyone is very willing to fit in with anyone's particular requirements.

I have a particular interest in science and base most of my work on topics which have a large science content. I find this is particularly appropriate for young children. Because they are involved with first-hand experience the children work with enthusiasm. They are expected to evaluate their own work and to report back to the class, a group, or me. Obviously, I also plan carefully for other areas of the curriculum in order to work in a cross-curricular way.

In the work following, my topic was 'sound'. I noted the science concepts I felt were appropriate and made a topic web, then listed activities which would provide suitable experiences. My starting point was a story.

We made a collection of instruments; we have many percussion instruments in school, children borrowed others from their families, and I took the front boards off our class piano.

The children spent some time in an initial phase of observation, exploring the instruments generally and trying to discover how they thought the sound was made. They are used to sorting activities and sorted the instruments using their own criteria.

Working with my thirteen top infants, I suggested they collect information about the instruments, which could be put on the computer in OUR FACTS. They are familiar with this program. In a group the children suggested their own field names, then worked in pairs to collect their information. I feel this is a very useful way to work as all can contribute at a level appropriate to themselves. A pair of more able children timed the length of a sound made by the instruments, other children recorded the material of the instruments, how they were played, what was used to play them etc. Everyone was dealing with something different so everyone's information was both needed and valued.

We came together after a few days when they felt they had finished gathering information and put the field names and their information into OUR FACTS. The children are very confident with the computer. Previously they had noticed the importance of correct spelling: where they will recognise a word incorrectly spelt, they know the computer will not.

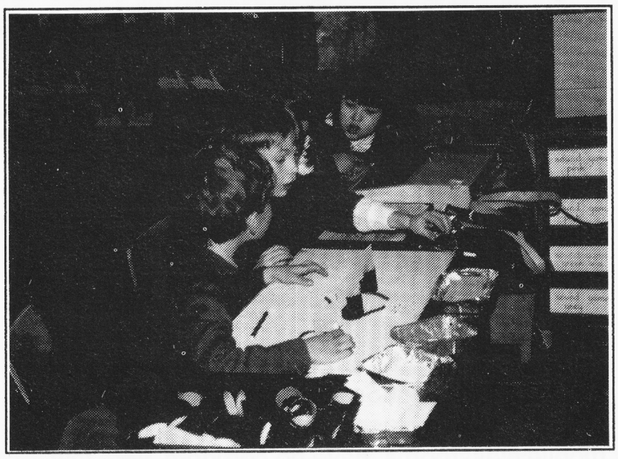
One child, looking at a file they had constructed, noticed the graphs were not appearing in the way she was expecting because of a misspelt word. Without referring to the information on the program or telling me, she worked her way through editing the file and correcting the mistake, after which she came to tell me. She had probably seen me edit before (but I had always needed to use the documentation). We were able to take graphs from our data, print them out and use them to answer questions.

Using the same topic, the children worked with SORTING GAME. I feel this program to be particularly valuable. It makes children look at differences and similarities and formulate their own questions. The most important prerequisite is experience in sorting according to the children's own categories.

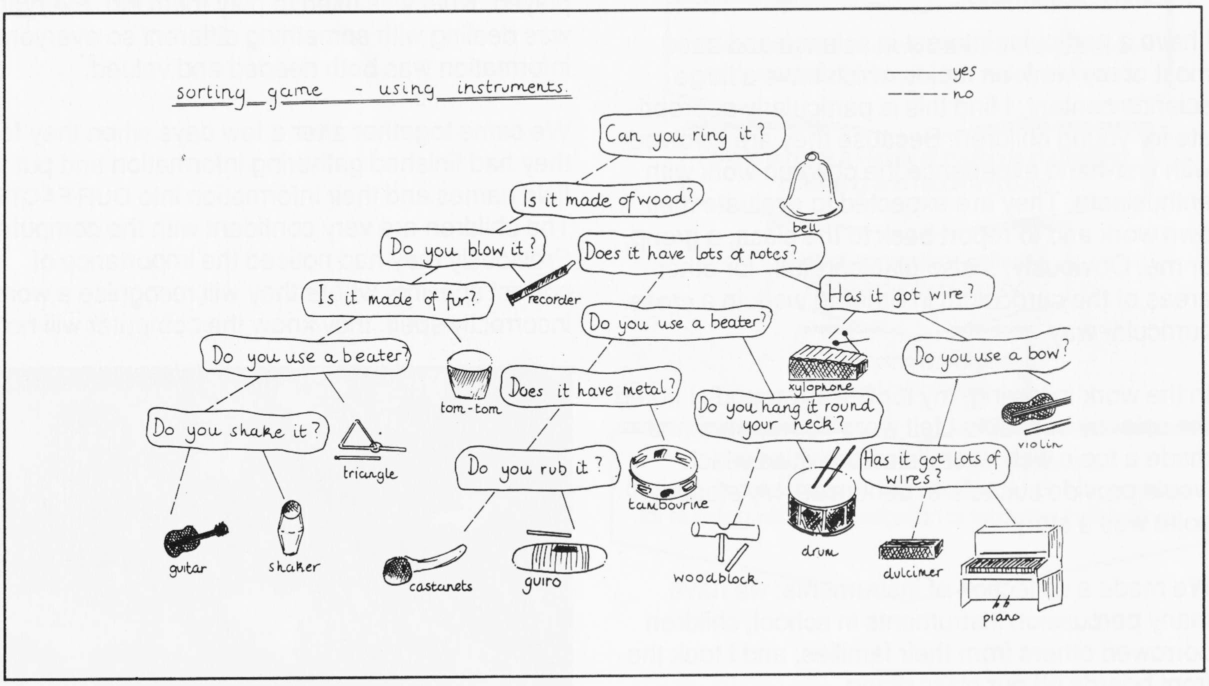
When they initially use the program, children will need help with making questions but as long as an adult is available this comes reasonably easily and quickly.

When I work with SORTING GAME I usually have three (possibly four) children. They work out their own rules about how many turns they have at each part before they change over. I expect the children to take the two objects, look at them closely and think of as many questions as they can to differentiate between them. Then they decide to use one of their questions. I find this process very valuable, both for developing close observation and for group decision-making. As long as they formulate their questions from what they see, hear, feel, etc., there can be no fear of being right or wrong.

Once the children have decided on their question, one child types it into the computer, another writes it on a piece of card and the third draws the object on a different coloured piece of card. They clip the question on to a flannel-backed card and lay it at the top of a flannel board. The children then put two felt strips, one red (No) one blue (Yes) leading from the the question. The picture(s) of the instrument(s) are slotted into cylindrical holders (pieces of kitchen roll centre, covered and cut with two slots) so that they stand up, then the children move the pictures along the appropriate strip.



Once they have followed the procedure in the program it returns to the beginning and they choose another object, in this case another instrument. The computer will ask the first question, and depending on the answer they will then have to differentiate between the new instrument and a tambourine or a bell. Below is a copy of the final map made by groups of children.



As the felt strips can be moved, spacing isn't a problem. The program can be saved at any stage and added to later, which is what we did. It took a few days to make the one shown. It isn't a speedy process since at each stage they need to look closely at the two instruments involved. They may have a lengthy discussion about just one question which may be discarded. Sometimes children start testing, e.g., does it float? They learn that terms linked to measurement, big, small, long, short, need to be more closely defined: longer than 10cm, for example, since 'big' when used for one object in relation to two specific objects may not be valid when it is in relation with another.

I have recently become interested in the use of a Concept Keyboard. Using the programme CONCEPT I am able to use the keyboard with SORTING GAME reducing the typing time. A Concept Keyboard needs to be carefully used with SORTNG GAME: it could lead to children looking for attributes on the keyboard rather than formulating questions from the objects themselves. In making overlays I use the words the children have used previously with the same collection. It is important that the children look carefully at the two objects involved at each stage and pose their questions when they have decided on one. Then they can look at the Concept Keyboard to see if it is of any help to them.

Usually I put questions beginning "Does it have...", " Has it got... ", "Is it... ", which I have found children use, on SORTING GAME overlays, but I have also used the same overlay with PROMPT/WRITER and used the Concept Keyboard in transactional writing.

Work on the computer like this needs someone in the group who can read. My top infants are all readers, as are some of the middle infants, so I can ensure that in any group there is someone who can read.

These activities could work towards the following National Curriculum attainment targets in Science.

AT 1	Exploration and Investigation
AT 6	Types and uses of materials
AT 12	Scientific aspects of Information Technology
AT 14	Sound and music.

2. Seeing Patterns in Data

Heather Monaghan, Advisory Teacher, Bedfordshire Primary Science and Technology Centre

Photographs by Nina Brodie

Wigmore Primary School in Luton stands high on the hill within sight and earshot of Luton Airport. It educates 225 children between the ages of four and eleven. If you visit you will be struck by the friendly atmosphere and a notice in the entrance hall inviting you to take part in the school's activities. Circumstances here are no more ideal than in many schools and though there are plans to increase the amount of hardware, at present the school has four computers used in a flexible roster of two weeks on, two weeks off and there is a queue for the printer at break times.

This term the whole school has been involved in a topic on 'movement'; the infants have used FOLIO to help with recording; the first- and second-years have used the computer for data handling and the third- and fourth-years have used an adventure game called THE MAGIC TELEPHONE as the stimulus for all manner of scientific and technological activities.

As advisory teacher for science and technology I was invited to help run a parents' evening which was to include 'hands on' activities to share the children's enthusiasm and the school's philosophy with parents and governors. The hall buzzed with activity while parents and children tested the best sail shape for a variety of boats, whirled autogyros of all shapes, sizes and materials; investigated pulleys and ramps and constructed a space rocket from a kitchen roll holder and several rubber bands. Another group, assisted by Linda Dowson, a first- and second-year teacher investigated the length of standing jumps and entered the data into a computer.

I talked with Linda and her two colleagues Elaine and Caroline, who all teach mixed classes of first- and second-years to enquire how useful they had found the software with their classes of thirty seven to eight-year-olds. Linda explained how she had organised her classroom in order to allow everyone access to the computer.

The school works an integrated day so that groups of children would be simultaneously engaged, for example, in writing workshop, maths, puppet-making and science, (which would include data collection as well as entering it on the computer). The children at the computer work in groups of three taking it in turns to enter one set of data each in the file. This ensures that each child has an opportunity to practise keyboard skills and does not have to wait too long for a turn. When the children are using a new program one child from the original three remains at the computer with the next group to go through the menu, remaining with the new group until they are confident in its use. Next time one member from this group will stay to help another new group.

This 'cascade' model works very well in practice and prevents the creation of a class 'expert' who consequently spends a disproportionate amount of time at the computer.

The 'movement' topic has been developed through all the areas of the curriculum. Technology involved designing and making puppets, several realistic ghosts and jointed skeletons were suspended from the ceiling and a puppet theatre was under construction. The comical movement of the jointed puppets led to an investigation of human movement which was developed through P.E. and this in turn led to specific (and competitive) investigations regarding individual muscle power.

Who could jump the furthest ?

Who could leap the highest ?

Can tall people leap higher than short people ?

How could we find out?

Do we need to test everyone in the same way ?

What data will we need to collect ?

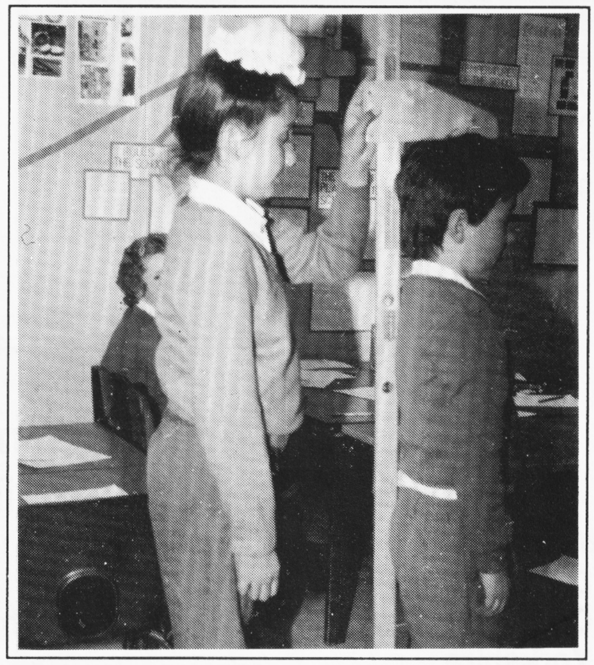
The children designed their own data collection sheets; these included height, stretch, sitting-height, hand-span, foot-length, circumference of chest and waist as well as length of leap and, incidentally, involved collaborative work with rulers and tape measures in order to complete.

The children began to look for patterns in their results. It was easy to decide from the evidence who could jump the furthest but much more difficult to discern a pattern in the statistics. They enjoyed entering their data into the computer. At first they used DATA SHOW. They had been working on bar graphs in Maths, making their own; now they could have the information quickly at the press of a button. It could also be translated into a pie chart and the children were able to see the same information again but in a different form.

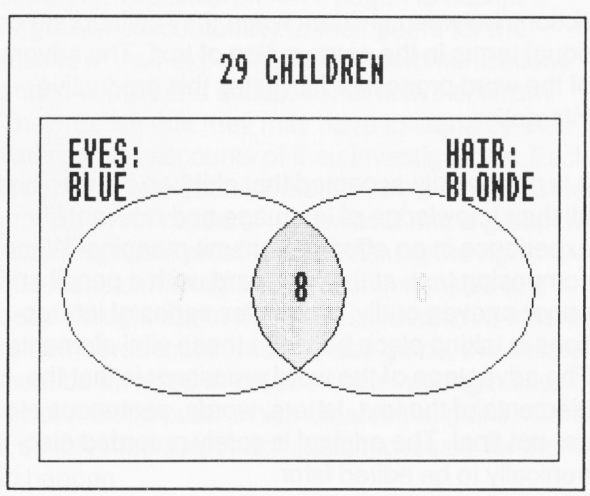
Further discussion with the teachers revealed that there were certain short comings, not in the software itself but in the match between what it offered and the capability of the older children. Some of the second years, already on Peake 4 Maths, could anticipate the screen display and didn't see the point in printing it. Linda felt they could cope with something more complex:

"We ought to be able to use the way they think and let the computer help. We ask children questions they find difficult to answer, the way they record is very laborious. If they need to sort and analyse whole class statistics in order to look for patterns and draw conclusions they need a program to help them to do it". I arranged for them to try OUR-FACTS.

The children could now enter the whole class's jumps as a file. They could select six headings for fields, for example name, age, sex, height, reach and jump. They could interrogate the file to find, for example, the number of jumps more than 173cm, graph their reach in centimetres, produce a scatter-graph showing height in centimetres or a Venn diagram showing how many girls jumped more than 173cm. In each case they spontaneously referred to their original file print-out to interpret the graph, and there was plenty of evidence that they could interpret correctly with comments such as "I'm in that number" and "This is Sundeep because he's the tallest".



The Venn diagram, although not used in their maths for the past two years was quickly recalled from early sorting activities in nursery and infant days. They also tried the cumulative count graph but found this and the scattergraph more difficult to understand; Elaine felt the cumulative count would be relevant and more readily understandable next term when they plan to grow beans. Her one regret was that there was no line graph facility as she felt this would provide a logical progression at this stage.



All three teachers and their classes quickly became confident in the use of this software for data handling. They found it easy to use and an excellent support to their investigations. In this case the teachers felt its use had been exploratory and that although this was appropriate in its use initially, they plan to structure data analysis more closely in future.

In these days of new initiatives and crowded timetables teachers may well be interested in the extent to which stimulating investigations such as these are compatible with the requirements of National Curriculum. In particular, these activities could work towards the following attainment targets:

Science

1	Exploration of science
2	Variety of life
4	Genetics and evolution
12	Scientific aspects of information technology and microelectronics

Maths

1	Using and applying mathematics
8	Measures
9	Using and applying mathematics
12	Handling data (collect and record)
13	Handling data (represent and interpret)

English

Speaking and listening, writing, spelling.

The contribution to primary science of collaborative writing on a word processor

D.M.Clough, Headteacher, Glusburn County Primary School, Skipton, North Yorkshire

The last few years have seen wide recognition of the advantages of collaborative writing, largely as a result of the use of the word-processing facilities now available to schools.

In the past, the many advantages of children working together, in pairs or small groups, were largely unrealised due to problems of organisation and supervision. There are many gains to be made from the cross-fertilisation of ideas and the interactions between children when they collaborate on equal terms in the composition of text. The advent of the word processor facilitates this productive interaction.

It is now widely accepted that children bring to bear all their knowledge of language and relevant life experience in an effort to transmit meaning. When composing text, at the keyboard, with a pencil and paper or even orally, a complex series of interactions is taking place between these vital elements. The advantage of the word processor is that the elements of the text, letters, words, sentences etc. are not final. The original is safely recorded electronically to be edited later.

A number of things happen when the freedom from the fear of marking, corrections and rewriting is coupled with the sharing of ideas and experiences between the group of children who are composing text with the intention of accurate transmission of meaning and effective expression. The children are eager to discuss, and hence more deeply process, the information and how to best transmit their meaning to their readers. Discussions involve the best use of words, correction of spelling, syntax and punctuation in order to make the meaning of their writing as clear as possible. A number of different versions can be tried and evaluated by a different audience.

The ability of children within a group to discuss their work leads to this rehearsal of the elements and language of complex topics but the real test, and arguably the most productive phase of the process, is when a group of proof-readers attempt to make sense of the product. This phase is usually followed by major editing.

The skills of composition of text, really the transmission of meaning by means of the written word, are constantly being exercised across the curriculum.

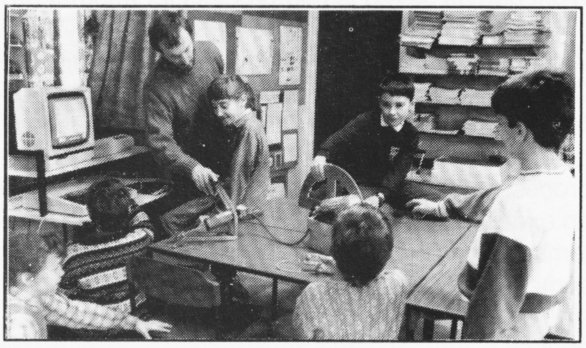
Nowhere are the opportunities for purposeful writing and discussion greater than those provided by the need to record or communicate accurately and concisely children's first-hand experiences of practical investigations. In our school the use of word processors has allowed us to maximise the benefits of recording as part of the scientific process. I believe that we are now gaining the benefits which interaction and discussion can bring when groups of children work together sharing and recording common experiences.

In the science activities which I encourage each group of investigators has access to word-processing facilities, a BBC computer with either WORDWISE PLUS or INTERWORD for the older children and programs such as WRITER or FOLIO along with a Concept Keyboard for the younger children. Each group has a group of proof-readers attached to it. The groups are deliberately held to a size which will ensure discussions and productive debate. As the children complete their investigations, they compose their writing at the keyboard before asking the proof-readers to go through it. The readers are expected to criticise and discuss the writing and to work alongside the investigators to achieve a clear transmission of meaning with all detail attended to.

Over a period of time, the proof-readers have become quite critical of the writing and have begun to expect that much of the editing will have been done alongside the composing. This is in fact the case.

The children have become much more self-critical and have begun to attend to more of the higher level editing at an early stage in addition to the conventions of language, such as punctuation, spelling and syntax. In the early days of this approach, this often meant constantly referring back to the investigation or even repeating an experiment to collect the necessary detail for the rewriting.

This was soon replaced with much more careful attention to the detail of the investigation, better observation of the process, results and minutiae and note taking. The children store their work on disk, to free the machine for other groups, whilst returning to the investigation to collect further detail or to clarify some point.



The requirements of the proof-readers lead to changes within the text which include:

- correction of spelling, syntax and punctuation in order to enhance transmission of meaning
- expansion at beginning, end and within the text
- attention to greater detail or deletion of unwanted clutter
- moving blocks of text around to maximise the effects of sequencing
- decisions regarding correct positioning of graphs, tables, diagrams within the text etc. for maximum effect.

The ability to effect all these changes easily is the key to the burden of redrafting records. No formal, standard format is required. The children are free to tell the story of their investigation without physical constraints and this leads to a greater understanding. The children have begun to accept a degree of accountability to their peers for the results of their experiments and communications and to expect and accept constructive criticism. They realise that they may have to stand by their findings and accounts of their investigations. Each group of investigators/writers is, of course, another group's proof-readers. It is evident that a group of knowledgeable proof-readers asking the right questions can bring about much extensive and deep thought about the material in hand. It must be remembered that to make these gains, the children must be involved in *collaborative* writing tasks. It is not the computer which creates the gains; rather it enables the sort of activities necessary for them to happen.

There is no justification for using machinery when pencil and paper methods will do just as well but the ability to edit mistakes, improve, enhance, expand, re-sequence and save text electronically is sufficient justification for this purpose. Hard copy, on paper, is available at the touch of a button, in fact some children prefer to edit from hard copy. Work can be saved in mid-process for another day.

Very young children can be given the help of a Concept Keyboard in their introduction to purposeful writing tasks, which can include key words represented by pictures or symbols. Simple word processing programs such as PROMPT/WRITER are an excellent introduction to more advanced systems such as INTERWORD, WORDWISE etc., whilst some like FOLIO are designed to be used alongside a Concept Keyboard and allow a choice of print size, typeface and page layout.

I believe that the constructive criticisms of the proof-readers, the comparatively deep discussion stimulated by children working together on purposeful writing tasks and the freedom from negative attitudes and disincentives created by rewrites, which are a feature of pencil and paper methods, have brought about a number of positive changes in pupil behaviour.

These include:

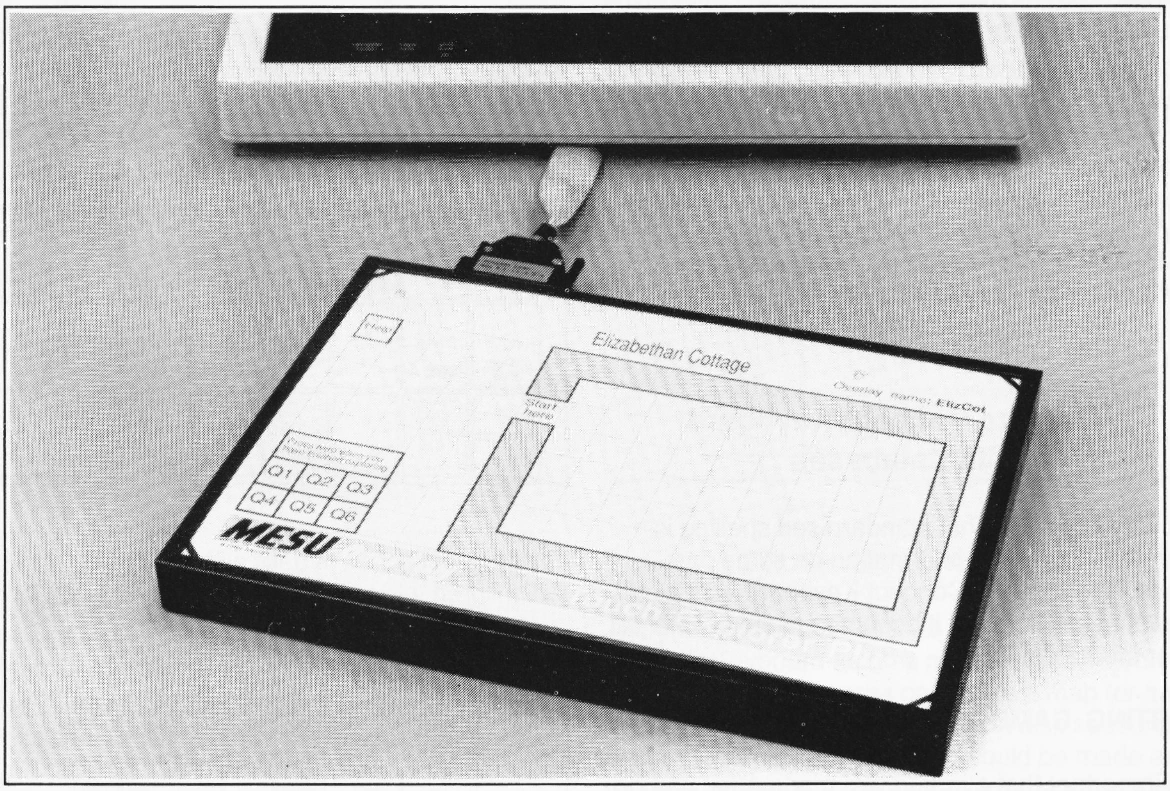
- increased goal-directed problem-solving behaviour and less redundant activity ~ a much more scientific approach
- much more careful thinking ahead in terms of design of investigations and control of variables
- improved and more carefully discussed reasoning in observation tasks and classification
- the development of 'on task' note taking showing careful selection of relevant material
- more attractive presentation of finished work which results in greater motivation, particularly of less able pupils.

Using a Concept Keyboard in primary science activities

Ann Orchard, Advisory Teacher for Primary Science, Avon

A Concept Keyboard is a touch sensitive pad which can be linked to the computer. It has a flat surface divided into 128 areas and each area (or blocks of adjoining areas) can be programmed to produce a different message. Overlays are put on the board, and can carry pictures, letters, words or phrases, so that one touch will display the written word on the screen.

Although the Concept Keyboard can make computer use easier for young children, at some stage they must begin to use the QWERTY keyboard. A mix of the two, almost from the beginning, may well provide the benefits of the Concept Keyboard, without making a difficult transition to use of the QWERTY keyboard.



Use of the QWERTY keyboard can be totally eliminated as overlays can include a lower-case alphabet in alphabetical order and editing keys such as 'return', and 'delete'. Overlays can be made by both teachers and children (seven-year-olds are able to key overlays into the computer).

It is important that children decide what they want to say before they look at the Concept Keyboard. It has necessary limitations in the messages carried, which should not be allowed to constrain the children.

Why use the Concept Keyboard?

Writing involves many skills, such as thinking what to write, spelling the words, and putting it all on paper. The Concept Keyboard simplifies this process, allowing thinking to proceed with less interruption, thus the children can concentrate on the activity in hand. Usually children will be working collaboratively, and where the group can become restless if one child is laboriously using the QWERTY keyboard, a Concept Keyboard can ease this situation. One great advantage of the Concept Keyboard is the time it saves for the children.

Recording in science serves various functions:

- remembering and communicating what happened, how an investigation was carried out, the problems encountered, and how they were tackled
- remembering and communicating data, needed during the activity, or to be compared with other data previously collected or data to be collected in the future
- reworking the experience, clarifying thinking
- recording the activity
- producing a record of the child's work
- communicating what was discovered.

A Concept Keyboard can aid any of these functions.

Some programs include a facility to make and use overlays, e.g. PROMPT/WRITER. To use a Concept Keyboard with programs such as SORTING GAME or MAKE AN ADVENTURE, overlays need to be made on the program CONCEPT.

Using the Concept Keyboard with databases

It is very important that standardised spelling is used when handling information on some databases. The use of a Concept Keyboard acts as a control to spelling and it becomes much quicker to enter the information.

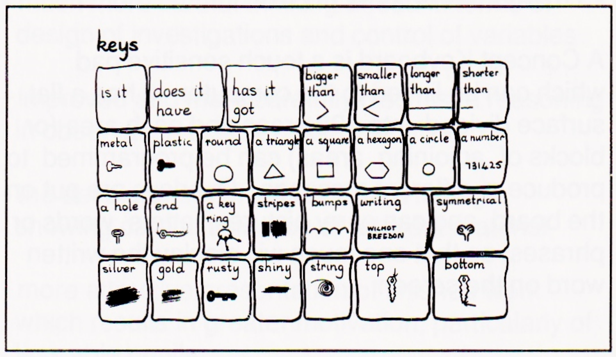
SORTING GAME

It is important that overlays are made *after* sorting activities so that the words the children use are put into the overlay.

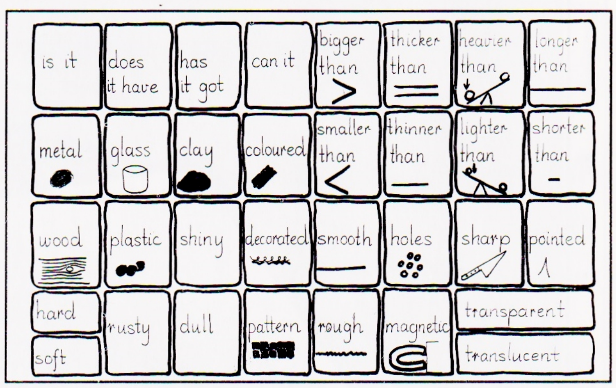
If the overlays are to be used only with SORTING GAME the typical beginnings of questions are useful, e.g. "is it", "does it have", "has it got", "can it". Children must raise their questions as usual from their observations, then refer to the Concept Keyboard. They will need to use the QWERTY Keyboard as well since they often need to use words not on the overlay.

examples

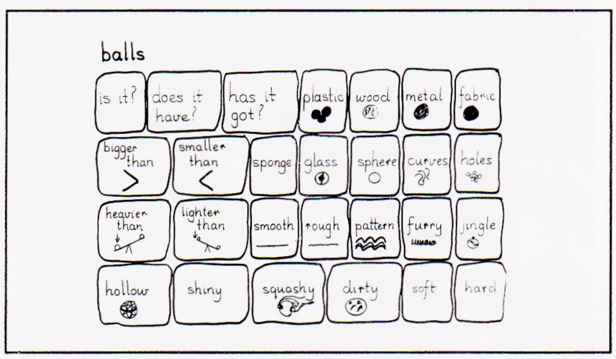
- A class of 6- and 7-year-olds put nearly 30 different questions into SORTING GAME when working with a collection of keys.



- A collection of containers has been profitable in developing ideas about materials.

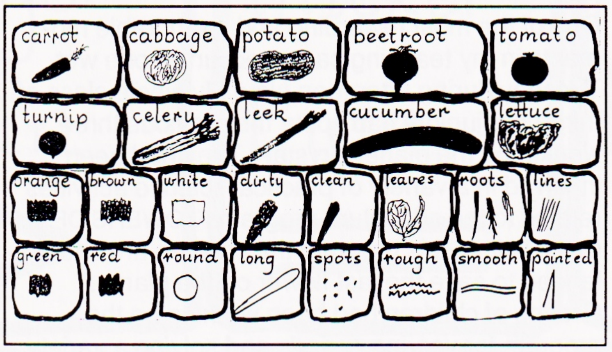


- Using a collection of balls with SORTING GAME led children into testing to answer their questions.

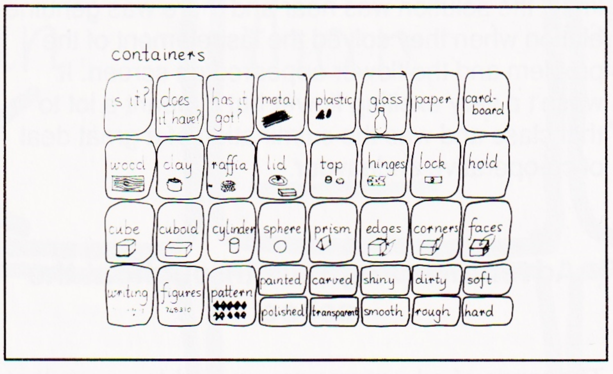


Word processing

Appropriate overlays can be linked to any science activity. They can also be adapted to this and the preceding programs, allied to the appropriate software.



The above was used for children to record science activities with vegetables using PROMPT/WRITER. The overlay below was used with a collection of containers.



The same overlays were also put on disk with CONCEPT for use with SORTING GAME. (The children have to key in their questions). In recording science activities, the use of the QWERTY keyboard is also necessary since it is impossible to predict exactly what words the children will need.

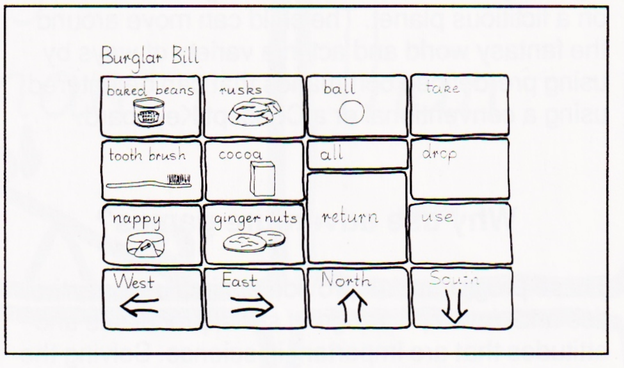
You can structure the recording of a science activity using a Concept Keyboard by putting central questions or statements on the overlay.

- What did we observe?
- What did we ask ourselves?
- What did we think would happen? Why?
- How did we test?
- Was our test fair?
- Did it test what we wanted?
- What do we think now?
- Do we need to test further?
- What did we find out?

Adventure games

The use of the QWERTY keyboard can be eliminated totally since the responses are defined, thus, once the children have made their decision they can immediately proceed with the adventure. The overlay also notifies them of the range of responses.

An overlay made by teachers, based on the book *Burglar Bill*. This also was of use with a similar adventure. Good photographs of a wide variety of houses and a collection of building materials were used.



TOUCH EXPLORER PLUS

This program can be used to define areas on the Concept Keyboard as on a map. Children involved with a conservation area can make a map for an overlay, then collect and record on disk seasonal changes. Similar observations could be made and recorded about any part of the close environment, e.g. a wall, tree, stone pile, etc.

Simulations

As with adventure games the responses are defined so can be totally linked to the Concept Keyboard.

Once made, overlays can become part of a central school resource, to go with collections, or with defined science activities linked to the National Curriculum.

Using adventures and simulations

Ron Ritchie, Senior Lecturer in Primary Science and Technology, Bath College of Higher Education

The computer can create fantasy and realistic simulations that can stimulate, support and enhance primary science activities.

Adventure programs

Adventure programs which simulate a fantasy world that children can explore and within which problems can be posed provide an excellent stimulus for rewarding and enjoyable cross-curricular work. This work can include practical science and technology activities which are linked to the program's theme or content. The problems posed by these programs may involve completing a journey or a task such as saving the last flower on a fictitious planet. The child can move around the fantasy world and act in a variety of ways by using pre-defined commands that can be entered using a conventional or a Concept Keyboard.

Why use adventure games?

These programs can provide a stimulus for activities and develop a range of skills, processes and attitudes that are important in science. Solving the problems involved in these programs requires a variety of strategies and involves creative and lateral thinking. There is often a need to make predictions as a result of adopting an initial trial and error approach.

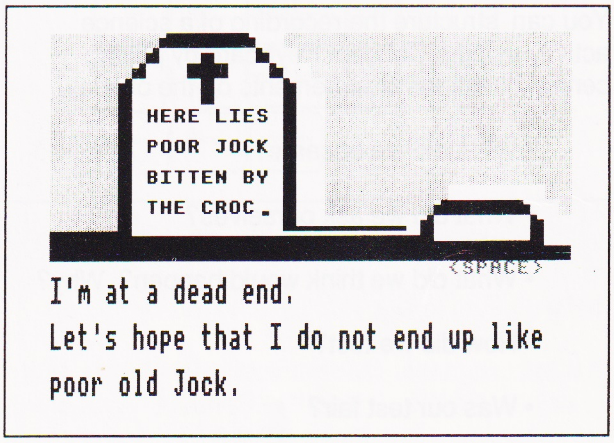
Tackling adventure programs also provides one of the best situations in a primary classroom for purposeful recording of information. If one member of a group inaccurately records some information it can make the resolution of the task impossible and this soon becomes apparent to the children. With suitable teacher encouragement they will start recording with care and trying to find ways of organising the information. Sometimes notes or a table are appropriate and on other occasions a map or grid can help clarify information.

Working on these problems in small groups can provide an excellent focus for group discussion and foster attitudes of co-operation, open-mindedness and tolerance of others' views. The successful solution often takes a considerable time to achieve and perseverance is required. However, the enthusiasm and enjoyment that can be generated by adventure games usually means that the concentration span of the children and their commitment to the task is high.

One of the most rewarding and memorable moments in my teaching career occurred one wet Tuesday during afternoon play. My whole class of third-year juniors had spent the previous three weeks "on the planet Crystal". They had been involved in a variety of practical science activities related to the adventure program FLOWERS OF CRYSTAL. In this program the children are challenged to save the last flower on the planet. Groups of children had been working on the program for varying periods and solving a variety of problems. It had provided a great deal of motivation and regular requests to continue during playtime. Sarah and Tracy were on the computer and in possession of all the information gathered by the rest of the class over that period. We all knew the solution was near and there was genuine elation when they solved the last element of the problem and the flower appeared on screen. It wasn't a very exciting flower but it meant a lot to that class and was the culmination of a great deal of co-operative endeavour.

Adventure programs throughout the school

The range of adventures now available means that children can be offered progressively more demanding challenges throughout their primary schooling. Simple programs like LITTLE RED RIDING HOOD or MAGIC TELEPHONE include a limited number of locations and a restricted range of simple commands and problems.



However, young children still have great difficulty conceptualising what is involved in moving around a micro-world on the computer and for this reason successful use of an adventure will usually require that:

• it is introduced or set in a context that is relevant to the children

• it is offered to children who are ready to cope with the level of difficulty of problem it involves

• it is supported by appropriate activities away from the keyboard

• adequate time is provided at the keyboard to allow the children to discuss strategies and options and learn from their mistakes

• work at the computer is supported with appropriate concrete experiences including aids (models, maps, pictures etc.).

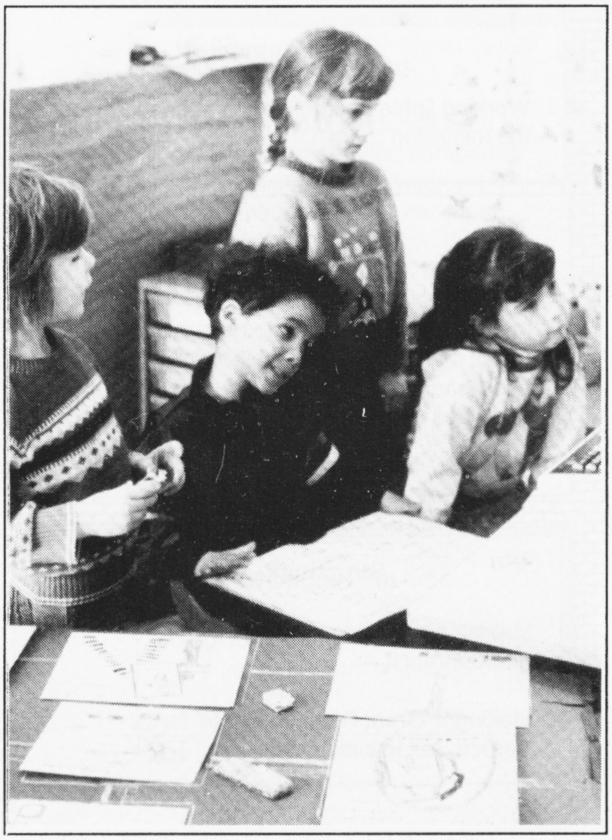
The following case study, illustrating this approach, was based on the programs MAKE, EDIT AND PLAY AN ADVENTURE. This set of programs allows children or teachers to create their own simple adventure game based on any theme they choose. MAKE AN ADVENTURE allows the user to create a scene with between six and sixteen locations, each of which must be connected to another on at least one side. The starting point for the exploration is specified and remains constant. A number of objects need specifying and these are distributed at random, by the computer, throughout the locations. A hazard which will obstruct the collection of objects, and its antidote, are also required. The resulting adventure involves the objects being collected and returned to the starting point.

Charlie and the Chocolate Factory

This adventure was written by two ten-year-old girls who worked in co-operation with a middle infant class. The infant class were involved in a variety of activities based on Dahl's book *Charlie and the Chocolate Factory* and had recently been to see it performed at the theatre. The infant children chose the rooms or locations they wanted to include in their adventure and illustrated each one. They also chose the objects to be collected and the 'evil' to be overcome. The two older children then used the adventure generator MAKE AN ADVENTURE to produce the game, writing descriptions of each location and deciding upon the factory layout. The resulting game was saved on disk to be used with PLAY AN ADVENTURE.

Tackling the adventure

After a reminder about the story the younger children were introduced to the program by their teacher. In groups of four they then tried to solve the adventure and were encouraged to do this in two ways. They were given the location of the first room on a large floor map, which indicated the layout of the rooms but not which was which, and asked to explore the rest of the factory. A model figure of Charlie was moved to the next location prior to the instructions being typed into the computer. Each move was discussed by the group. The picture of the new room was found (by the child given responsibility for these) and placed on the map along with any objects present, according to the computer description (another child was responsible for these).



When mapping was complete the children set about collecting the lost objects and overcoming the 'evil' Mr Fickelgruber. Any object collected was physically removed from the map and placed in a basket beside the keyboard and similarly any object dropped was returned to the map in the correct location. Groups took about 30 minutes to complete the adventure and return all the lost objects to the 'Chocolate Room'. With the help of the models the children were able to cope with a fairly challenging problem-solving task.

The computer-based work stimulated a range of cross-curricular activities away from the computer which culminated in the construction of a 3-D factory to replace the map they had started with.

The work, which lasted almost half a term, included the following science activities:

Charlie and the Chocolate Factory

Electric circuits

Working lights and buzzers and an alarm for the television room

Floating and sinking

Making boats to sail down the 'river of hot melted chocolate'

Levers and pulleys

Making machines in the factory; investigating tools that use levers, nutcrackers in the Nut room; making aids to help the short Oompa-Loompas pick up things, and a device to save Augustus Gloop after he 'goes up the pipe'

Materials

Testing sweet wrappers to see which are waterproof; which wrappers can you see through? what colours can you see through them?

Testing the elasticity of materials including gum and blowing bubbles

Structures

Making and testing a bed for Charlie's grandparents;

Making a 'Great Rubbish Chute' for Veruca Salt to slide down

Food activities

Making sweets; dissolving and melting; observing changes to milk over a period; preserving food; fair-testing~ who likes different chocolate best? which colour Smarties are most popular?

Sorting and classifying a collection of nuts

Although the story line and the nature of the problems is severely limited in this program it still has considerable potential. Work with other infant classes has proved that 6- and 7-year-olds are quite capable of producing their own adventures. Some teachers have generated the adventures as a starting point for a particular topic or to support and enhance work on a theme or story such as *Mr Gumpy's Motor Car.*

After experience of these simple programs the children will be ready for more complex adventures like DRAGON WORLD and MALLORY before eventually tackling sophisticated tasks like FLOWERS OF CRYSTAL. A school policy should help prevent unnecessary duplication and ensure progression and continuity.

More complex adventure-generating programs are also available for use with older children including one which can be used in conjunction with the word processor PEN DOWN.

Many of the commercial adventure programs now include teachers' information that suggests suitable practical science activities that can be included in the work done away from the keyboard.

MAPE members might consider reusing one or two adventures from earlier collections and exploring their science potential.

MAGIC TELEPHONE (Part 1a, MAPE 4) can be used as a starting point for the following activities for middle and top infants:

Sound

ways of making sounds; testing which materials sounds travels through; string telephones; making sounds louder/quieter; hearing tests; pleasant/unpleasant sounds

Light

collection of torches - which would be best in the cave?

Structures

making buildings to add to the map; making a well with a pulley system to raise the bucket

Materials

testing thread/string/rope to see which is strongest; investigating a collection of springs and springy materials; making a 'Bounceman' that bounces along

Electricity

making a light for Alf in the cave wiring up a buzzer to warn of intruders into the cave; making a switch for the light

MALLORY (MAPE 3) is a good stimulus for forensic science and its editing facility allows children or teachers to modify it to suit their needs or interests. The following are starting points for activities tried with first - and second - year juniors:

Making prints

footprints (in sand) or shoe sole rubbing; finger-prints for sorting and classifying; ways of removing prints from glass or dust tyre-tracks; identifying cars plaster casts of tracks in earth etc.

Magnifying

observing small evidence such as hairs with a magnifier; comparing dog/cat/human hair; examining chips of car-paint

Chromatography

identifying felt-tip pens or inks

Changes with time

aging objects and materials according to amount of decay.

The context and motivation generated by adventure programs can lead to practical work of a high standard and the computer use will have genuinely supported, enhanced and extended the science experiences of the children.

Simulation programs

The ability of the computer to model or simulate the real world can be used by primary teachers to provide experiences for children that would otherwise be too expensive, dangerous or simply impossible. However, before exploring the use of realistic simulations it is important to remember that practical first-hand experiences are at the heart of primary science and I.T. should never deny children the opportunity to try things for themselves.

Why use simulations?

There are a number of ways in which simulations can enhance, enrich and extend practical experiences for children. They can provide particularly valuable ways of encouraging children to raise questions, to hypothesise and investigate: "I wonder what would happen if..?". Children need to learn to control variables in scientific investigations and they can be encouraged to do this in a structured or open-ended way using a computer-based model. The experience of using a simulation can be extremely motivating and there are few children who will not respond to the challenge of flying a hot-air balloon or glider. Depending on the content of the program the children will be developing their scientific knowledge and understanding in line with the national curriculum programmes of study. Many of the attitudes developed through the use of adventures will also be fostered by simulation programs. In particular, children's ability to empathise will be developed and their decision-making skills considerably taxed.

It is vital that simulations are supported with relevant practical activities and that the children are prepared and able to cope with the conceptual and problem-solving demands made by the program.

Some teachers may choose to use a simulation as the focus of several weeks' cross-curricular work. Others will use a particular simulation to support one aspect of a topic, perhaps with just one group of children.

Some simulations provide very simplified models and none of them can truly provide experience of the range of factors or variables involved in a real situation. However, this need not cause primary teachers too much concern since introducing young children to particular processes, ideas and concepts often involves making generalisations and simplifying complex situations. A bigger problem for early years teachers is the lack of suitable software and with one or two exceptions, like JUMBO, there is little available.

Examples of classroom use

The first example involves simulating plant growth using the computer and this may immediately cause you to question the appropriateness of such a program. Does it not fall into the category of programs that deny children first-hand experiences? There is no doubt that children should be growing plants themselves and there is no suggestion in this example that they should be discouraged from doing that. Indeed, the starting point for the work was a topic on growing things and the class had been investigating plant growth under a variety of conditions. However, the teacher's desire for them to handle more data and develop a better awareness of the variables involved was satisfied by getting them to use GROW A PLANT. This program allows the children to investigate the growth of fictitious plants (closely related to real ones) in a variety of conditions. The location can be varied and includes a cave, a wood and an industrial site and the seed can be planted at any time of the year. The plant can be fed a variety of 'foods' and watered at different times. You can even simulate talking to your plants. The resulting growth is shown and provides a wealth of data for the children to collect.

Initially, the third-year junior class using it were given the opportunity to explore the program without guidance. After several trial runs the group of three involved challenged themselves to try and grow the tallest 'Tattywort'. Randomly changing the conditions became frustrating and one girl suggested changing one thing at a time. Using this strategy they soon discovered the best month to plant the seed. The need to control variables carefully had arisen naturally and as a result of their 'investigations'. Further groups continued to investigate the simulation and before long graphs were being produced to show the effects of different factors. When later groups explored another plant they used these graphs to formulate their own hypotheses which they could then test. The program considerably enriched the experience this class gained from growing their own plants.

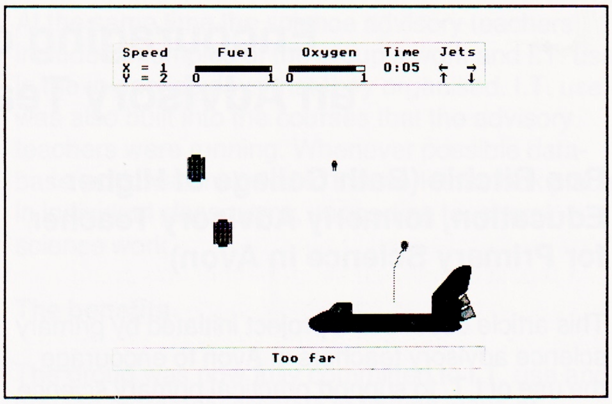
In an ideal world, allowing the children to investigate the result of planting a seed on a mountain side in January may be desirable but this class can certainly predict the likely outcome! SUPER SEED offers a similar potential.

SUBURBAN FOX is a different kind of simulation which allows children to take on the role of a fox and try to survive in a range of environments. The children are required to empathise continually with the fox and make decisions that affect its chances of survival. These decisions involve using their senses to search for suitable food and locating places to hide and sleep within their 'territory'. Their progress can be saved on disk so that they can return to their 'fox role' at a later date. It is a complex program that needs a great deal of preparation and quite a lot of keyboard time. A 4th-year junior class recently used it as the focus for a half-term's work on an integrated topic about 'Hunters'. The program was supported by a range of practical activities which were planned by the teacher to help the pupils understand the needs, habits and life cycle of the fox. The children worked in pairs and had fifteen minutes at a time to try and survive the longest 'as a fox'. Their adventures provided the basis for a variety of written work including a 'Fox Log' with a map of their explorations. A similar program called PIPISTRELLE allows children to take on the role of a bat and use echo-location to locate food in an attempt to build up sufficient body weight to survive hibernation.

Supporting a topic on 'Transport'

There are a number of simulation programs that can support or enhance a topic on 'Transport'. MAPE members will be familiar with the program LOCKS. Although rather dated and simple this program still has potential for challenging children to solve the problem of getting a canal boat through a lock system. After a trip to the canal and possibly an interview with the lock-keeper this simulation provides a valuable follow-up and certainly allows them to make mistakes that they could not make in the real world.

In another third-year class I visited recently a pair of children were learning to fly a glider. They had built a 'cockpit' from cardboard boxes and other everyday materials which housed the computer. The monitor formed the cockpit window. The children involved had already experimented with paper aeroplanes and explored the use of control flaps and knew the effect they had on a glider's flight. They had explored the effects of hot air on paper spirals and read about thermals. The program GLIDER now provided the opportunity to put all those practical experiences to good use in an attempt to 'fly' the simulation. After a number of non-fatal crashes these intrepid flyers soon mastered the controls and were happily sharing their new-found skills with other would-be aviators, including the teacher!



HOT AIR BALLOON has similar potential for young flyers. For those who prefer to keep their feet on the ground, or at least flat on the accelerator, CARS: MATHS IN MOTION provides a complex and demanding simulation about setting up a Formula One racing car for particular circuits. It is a difficult program that tests the mathematical and scientific ability of the most able junior children but it has been successfully used by many classes. It is surprising what abilities children show when they are motivated! For the really adventurous teachers who have been looking for appropriate experiences to support a topic on 'Space' the simulation SPACE WALK is worth evaluating. It simulates an astronaut's movements in a gravity-free environment and can provide a useful support in an area not well suited to first-hand experiences.

Historical simulations

Programs like MARY ROSE and FLETCHER'S CASTLE also provide rich material as starting points for practical activities such as modelling the wreck, investigating the changes materials undergo in brine or investigating different building materials and ways of joining them. Another early MAPE program, MANGON that simulates the action of a mangonel also 'invites' practical work and the use of the simulation is considerably more valuable if the children have built and tested their own siege machines. The data from MANGON, and indeed others like GROW A PLANT can be profitably entered into a database or spreadsheet for sorting, analysing, representing pictorially and pattern searching.

The implementation of science as a core subject within the National Curriculum is going to be a challenge for many primary teachers. Support will be needed from a variety of sources and simulations may offer one reservoir that can be used. Appropriate use can certainly lead to valuable practical science activities, reflecting the best of primary practice, within an integrated curriculum.

Encouraging computer use ~- an Advisory Teacher Perspective

Ron Ritchie (Bath College of Higher Education, formerly Advisory Teacher for Primary Science in Avon)

This article describes a project initiated by primary science advisory teachers in Avon to encourage the use of I.T. to support practical primary science activities. The project involved working with a group of good practitioners who had made little use of I.T. and encouraging them to share their experiences with other teachers.

Forming a working group

There was an existing tradition in Avon for bringing classroom teachers together to form working parties for particular purposes. Discussion within the team of advisory teachers led to the suggestion of a 'Computer Working Party' to enhance existing good primary science practice through the use of information technology.

The intention was to recruit a group of good science practitioners who would be supported in exploring the use of I.T. in their own classrooms. They would be asked to write up their experiences in booklet form to be made available to other teachers. The core group, if convinced of the educational benefits of I.T. and science, would also be asked to involve other staff in their schools and disseminate their work through local meetings and workshops. The approach was intended to demystify I.T. and avoid the image of an 'I.T. Specialist' telling other teachers what programs they should be using.

It was not difficult to identify potential group members and we decided to work with a group of fourteen. The group included a balance of infant and junior teachers and covered a range of school types from the small village school to a large urban school. All had one thing in common: they had made little use of computers in their classrooms. They were invited to participate in the project and informed that it would last at least two years and involve them attending two daytime meetings a term (for which supply cover was available) and after-school meetings. The commitment from them involved trying work out in their classrooms within the constraints that operate there with, for example, no special computer allocation.

Two advisory teachers were chosen to co-ordinate and support the group, one of whom had considerable I.T. experience and another who was committed to I.T. use but lacked experience.

Getting down to work

The first full day of the Working Party involved general introductions and a sharing of experiences about I.T. and feelings towards its use. There was then a brief look at the range of computer applications that may have potential for science work including information handling, adventure games, simulations and word processing. The co-ordinators had already decided to concentrate on information handling during the first phase. The group then explored and evaluated SORTING GAME and OUR FACTS. They were asked to plan classroom activities that would be enhanced by using one of these programs. The group left at the end of the first day prepared to explore the programs' use in their own classrooms.

Several weeks later the group reconvened to share and evaluate experiences. An impressive range of uses was described and most of the group were very positive and regarded their work as a more appropriate use of a computer than they had previously experienced. All were adamant that the computer should not replace first-hand experiences that they regarded as an essential aspect of primary science. The uses ranged from using SORTING GAME with a reception class that was observing the ingredients of a Christmas cake to junior classes who had collected information about building materials and combined information from different locations. Some had used the computer during a short-term activity, others had used it over several weeks as the children collected weather data.

At this session some of the junior teachers were introduced to GRASS as a more sophisticated database and encouraged to explore its use.

The whole group were encouraged to keep written notes of their experiences and these formed the basis of the subsequent Working Paper. The mutual support offered within the group was a vital element of its success. Individuals felt secure and confident enough to share reservations and difficulties. This meant original ideas and approaches were constantly modified and inevitably improved. They were able to contact each other informally to sort out problems and discuss ways forward. Infant teachers benefited from talking work through with those teaching older children, and vice versa.

The pattern of trying work out in class, coming together and jointly evaluating the activities continued for two terms and the first part of the Working Paper began to evolve. The group decided to base much of the booklet on case studies and were keen to emphasise activities that happened away from the computer. The material was being written in a truly collaborative way. The co-ordinators acted as editors and at each stage of writing, draft material was reviewed by the whole group. Feedback on the material was encouraged by various interested parties and the ideas were trialled in other schools with inexperienced teachers.

Disseminating the work

Almost a year after the first meeting the database section of the booklet was completed and the first phase of dissemination began. In the meantime the group had chosen to explore the use of adventure games and were well into using MAKE AN ADVENTURE and other commercial programs.

The Database booklet was launched at a 'Primary Night', which was a regular event in the county, and attracted a large number of teachers to the local centre. It also featured in one of the regular Primary Science Newsletters. This was followed up by a series of local meetings hosted by pairs of teachers from the group, in one of their schools. All of these sessions were 'hands-on' with the opportunity to discuss with others how the work had been planned and organised in the classroom. A travelling display of children's work and models that the group had mounted went around from session to session. The programs were always available for purchase at these sessions although a common reaction was, 'Oh, we've got that in school, but I never thought of using it like that!' It was evident that quite a number of teachers at these meetings had not attended any in-service activity concerning I.T. before and had found the format of the meetings appealing and useful.

At the same time the science advisory teachers included examples of the group's work and I.T. use in the in-service days that they organised. I.T. use was also built into the courses that the advisory teachers were running. Whenever possible database work was included in the work that took place in individual classrooms, supporting teachers' science work.

The benefits

The group was now fully committed to I.T. use and proving extremely creative in finding ways of exploiting the science potential of software. The adventure game section took much less time to complete. It was added to section one of the booklet and a new round of dissemination began, with the group actively encouraged to involve as many teachers in their school as possible. The fruits of the project were now becoming more obvious and we were finding much more evidence of computers being used in schools to stimulate, support and enhance science work. Members of the group were being invited to share their new-found confidence and experience with a number of local, regional and national groups. Group members were recruited to run I.T. courses and organise in-service days for schools.

Subsequently the group has explored the use of simulations and word processing and these form the final section of Working Paper 8, 'Using Computers to Support Primary Science and Technology'. The final outcome is probably far less important than the process by which it was produced. Perhaps the people that get most out of any publication are those that write it but there is certainly some evidence that the booklet has encouraged other teachers to explore more effective use of a computer in their classrooms.The group of good science practitioners had become a group whose I.T. skills were now recognised and sought.

A group remains in existence (with some newly recruited classroom teachers to replace some who have moved on to other things) and continues to meet after school. On-going work includes more on the Concept Keyboard, data-logging and I.T. within the National Curriculum. The project has provided a valuable contribution to the county's in-service provision. Its costs, in terms of supply cover, were small and as is so often the case in education its success was due to the enormous commitment and dedication of classroom teachers who were prepared to share their professional expertise with others.

Using computers in primary science -- an INSET approach

John Wilson, Leeds Polytechnic, formerly Advisory Teacher for Primary Science and Technology, Barnsley

All INSET is to some extent a compromise. The trainers try to deliver in hours or days, experiences it may have taken them months or years to acquire.

As teachers we know that there is no real substitute for experience, so we should try to make courses on Information Technology as practically based as possible. There is a good case for involving tutors with the appropriate curriculum skills alongside those with an I.T. perspective.

The course, 'Using Computers in Primary Science' was planned around six evening sessions, each of two hours. The main aim of the course was to enhance good primary science by the use of I.T. It was thought that data handling was an important part of this and therefore it was decided that this should be the focus.

Working in a small authority had the advantage that we were able to bring on the course those teachers with an awareness of the features of good practice in primary science and a readiness to take on additional skills. Parallel to this course was a 'Science in a Topic' initiative involving one third of the authority's primary schools, mainly school-based with Advisory Teacher support. We would have liked to bring pairs of teachers from schools which would have helped support and disseminate school-based work but demand for places led to the decision to take only one from a school. In time all of the course members will receive school-based support for the science in their school but constraints of time limited this during and immediately after the course.

Session one

It was enlightening to talk to course members before we made a formal start. Some thought they were coming on a technology/control course. One group were relieved that they would not be expected to study how computers worked. Quite a few had come for the chance of meeting science software.

It came as a surprise to all the participants to find the room free from computers. This was a deliberate decision. We wanted to make the important point that our introduction, opportunities and methods for collecting data did not depend on the computer always being available on the timetable.

The first session was formally opened with an examination of a rationale for using I.T. to enhance good practice in primary science. Practical work followed when the teachers, of children ranging from 5 to 11, were given a series of tasks designed to be enjoyable, and enabling them to produce a data sheet about themselves:

How steady is my hand?
How quickly do I solve a puzzle?
What can I recognise by touch?
How quick are my reflexes?
etc.

Each teacher entered his or her results on a personal data sheet to be entered into a database later.

The need to economise on time meant that both the activities and the data sheet design were pre-planned, but we made the point that it would be good practice in science for their children to ask their own questions about themselves, devise their own investigations and agree on a common data sheet between them.

Session two

Three activities were provided in the second session.

1. A sorting activity, in which teachers were asked to sort one collection by as many different criteria as they could think of.

2. The opportunity to search, sort and draw graphs from the data about themselves collected in the previous session, using GRASS.

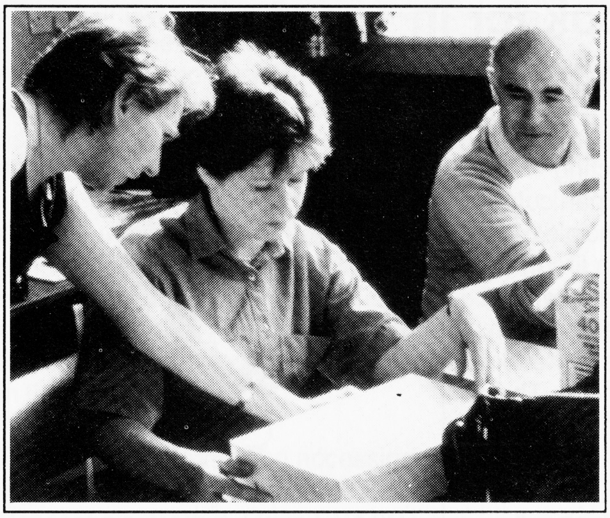
3. Making simple elastic-powered buggies. This would be the basis of a project in making a range of designs and measuring their performance.

Session three

Finishing and testing the buggies took up most of this session, leaving just enough time to consider the factors that governed the performance of the buggies:

Length of elastic drive
Mass of buggy
Number of wheels
Diameter of wheels
Wheel material
Test track surface
Number of winds on elastic

This time the teachers themselves were responsible for deciding on the fields in the database, determined from their hands-on experience.



Session four

This included time to examine the buggy database. We ended up with records for about twenty buggies, not really enough to draw any conclusions from the investigation. There may be a case for I.T. and Science advisory teams from several neighbouring authorities to get together in running the same activity on a number of courses, so as to produce a truly useable database. For a group of schools linked by electronic mail, a joint database from a shared investigation could be very exciting.

Session five

We looked at extending the sorting activities which by now all the teachers had tried, using the programs BRANCH and SORTING GAME. Those using BRANCH sorted breakfast cereals. The power of BRANCH in stimulating first-hand experience is that in order to complete the sorting task teachers or children must move, handle, test the materials and discuss their attributes. Teachers using SORTING GAME sorted spoons, packaging or textured materials, supporting the program with the three-dimensional branching tree activity.

Session six

This session gave teachers an opportunity to look at software for communicating results: NOTICEBOARD and DATASHOW plus a look at word processing using FOLIO. NOTICEBOARD is a computerised pinboard with short pieces of screen text that can be retrieved using a key word index. DATASHOW is a graph drawing program.

Session seven

This had originally been planned as tutorial time for the few we anticipated would want to extend their work and look at the additional software OURFACTS and FIRST FACTS. In the event everyone turned up and many took away copies of the software we were licensed to give them. Perhaps this attendance was an even greater measure of the success of the course than the positive feedback we got from the course evaluation questionnaires.

It was only possible within our Advisory Teacher programme to offer school-based support to two of the course members. One teacher used OURFACTS database and DATASHOW in an Olympic Games topic. Her class recorded their sizes, masses, pulse rates and so on, to see how these measurements compared with measurements of their running, jumping and other physical skills.

Another teacher used BRANCH to sort a collection of threads, cords, ropes and chains. Her class sorted by the properties of the materials. This involved testing and the results were entered on an OURFACTS database.

Both of these teachers are science co-ordinators in their respective schools and recognised by the advisory team in their LEA for their regular signs of good practice.

In evaluating the course we drew certain conclusion for future INSET:

• although we would repeat the evening sessions we would take teachers in pairs and provide continuing support for all the teachers in school

• we would conclude the course with a school-based assignment to be displayed in the Professional Development Centre of the authority. We regularly use this idea in other areas of science INSET

Teachers who most successfully use I.T. in their class investigations are those who are already good practitioners in primary science, where for their classes measuring, testing and comparing are already a feature of the exploration and investigation component of the science curriculum.

Conversely the least valuable experiences for the child as far as science is concerned happen where data is collected, largely from secondary sources, without real first-hand activities taking place and without children being given choice in their investigation and decision making. This message needs to be delivered loud and clear at the beginning of all Science with I.T. courses.

Special thanks to Carolyn Andrew and Peter Hardwick, Science/Technology Advisory Teachers, Longcar Professional Development Centre Barnsley LEA, who acted as supporting tutors on the INSET course described here.

What to look for in primary science software

Selecting any software can be a difficult task, but selecting software to support the teaching of science can prove particularly difficult if we are not to sacrifice the very important principle of children being involved in activities which are based on first-hand experiences. The guiding philosophy must be that the software encourages children to work in a scientific way. To that end the computer must help the children to make observations, collect data and record and interpret the findings they have made. The computer may also provide the initial stimulus for an investigation.

Below are a number of questions that can be asked which will help in the selection of software.

Is it:

- appropriate to the child's level of development?
- supported by other classroom resources?
- robust and easy for children to handle?
- compatible with a Concept Key board?
- user friendly; with clear messages and unambiguous instructions?
- flexible and extendable?

Does it:

- support, enhance or extend children's scientific work?
- stimulate or encourage children to work in a scientific way?
- promote scientific enquiry?
- use appropriate language?
- have a screen-dump facility compatible with your printer?
- protect valuable data (e.g. when the BREAK key is pressed)?
- suggest activities to be carried out away from the computer?

Useful Information and Resources

The following are useful sources of information that offer teachers support in primary science:

National Educational Resource Information Service (NERIS)

NERIS is a huge database of resources that can be accessed using your school computer and a modem attached to a telephone point. Included on NERIS is a number of files called STEPS (Science and Technology Education in Primary Schools). These have been written by classroom teachers who are willing to share their ideas and experiences. The files cover a wide range of topics such as Vikings, Weather, Light and Colour and the whole primary age range is supported.

Cross-curricular links are suggested and lists of suitable resources included. Whilst you may not use the material in the way described and there is only limited quality control built in to any entries there is much that can be gleaned for effective use in the classroom.

For more information on accessing and contributing contact Gerald Smith, MSTEC, Middlesex Polytechnic, Barnet, Herts EN4 0PT.

Data Handling in Primary Science

Contains software (including SORTING GAME, OUR FACTS and NOTICEBOARD) supported by a well-argued rationale, case studies and ideas cards plus a booklet to help teachers understand the benefits of I.T. As the need becomes apparent for increased sophistication the software provided allows the opportunity for progression. It constantly reinforces the principle that science involves first-hand experience.

Available from MESU Publications, Hoddle, Doyle & Meadows Ltd, Old Mead Road, Elsenham, Bishop's Stortford, Herts,CM22 6JN.

Micro Mindstretchers (BBC)

A series of five short programmes that stimulate problem-solving using the computer as an integral part of classroom practice. Each has a follow-up which shows ways of tackling the problem posed. The third programme encourages the use of a spreadsheet to deal with the results of a reaction time experiment.

Science Start Here (ITV)

This is supported by software including a variety of files for the KEY database. The programmes have been well received in schools and are recommended. The software doesn't always match the standards set by the programmes.

Modular Investigations in Science and Technology (MIST)

This is a novel form of information technology. It provides pupils and teachers with short modules of visual material, supported on screen with questions and challenges. It is on a series of video disks that require a special player. There are MIST Reference Centres all over the country where it can be seen in action.

Books and Magazines

Primary Science Review

The ASE journal, has featured useful articles including one on using GRASS for an investigation on parachutes (Issue 8) and another about word processing in science. (Issue 6)

Questions

Another primary science and technology magazine which has featured more general articles about I.T., 'Computer Allsorts' (Issue 1) and 'From Homebase to Database' (Issue 4).

Educational Computing and Times Educational Supplement

Both often have useful software reviews and more general articles which provide sound advice on practical classroom activities. *TES* examples include Proving their Worth, A Springboard for Investigations and In the Swim. *Educational Computing* is of interest to a wide audience who wish to keep abreast of current issues in information technology and its application to other curricular areas.

Acorn User

Often features educational articles by Chris Drage and others which include valuable advice. 'Simulations in Schools' (July 1987) is an example although the tendency is to concentrate on the software rather than the way it can be used in the classroom.

Using Computers to Support Primary Science and Technology

The outcome of the group whose work is described in an earlier article. One of the booklet's strengths is the inclusion of a variety of project outlines for each of the programs evaluated.

Children Using Computers

A new book by Anita Straker, that should be on every staffroom shelf. It covers the use of I.T. across the primary curriculum and includes a chapter on science and technology.

Computer Software and other Resources referred to in this issue

ARCHAEOLOGY
C.S.H. Ltd,
Town Hall, St Ives,
Huntingdon
Cambs. PE17 4AL
Tel:0480 66805

BRANCH (BBC)
Information Handling Pack
MESU Publications

BRANCH (Nimbus, RML 480Z)
Oxfordshire County Council,
Computer Education Unit,
Littleworth Road,Wheatley,
Oxon,OX9 1PH.
Tel:08677 3980

CARS:MATHS IN MOTION (BBC, RML)
C.S.H. Ltd,
Town Hall, St Ives,
Huntingdon
Cambs. PE17 4AL
Tel:0480 66805

CONCEPT (BBC)
MESU Publications,

DATASHOW (BBC, RML 480Z and Nimbus)
Information handling pack, MESU Publications,

DRAGON WORLD (BBC)
4mation Educational Resources,
Linden Lea, Rock Park,
Barnstaple, Devon, EX32 9AQ.
Tel: 0271 45566.

FIRST FACTS (BBC)
RESOURCE,
Exeter Road, Off Coventry Grove,
Doncaster, DN2 4PY.
Tel: 0302 340331

FLETCHER'S CASTLE
Fernleaf Educational Software,
Fearleaf House, 31, Old Road West,
Gravesend,
Kent, DA11 0LH

FLOWERS OF CRYSTAL (BBC)
4mation Educational Resources,
Linden Lea, Rock Park,
Barnstaple, Devon, EX32 9AQ
Tel: 0271 45566.

FOLIO (BBC)
Tedimen Software,
PO Box 23, Southampton,
Hants, SO9 7BD.
Tel: 0703 473774

GRASS (BBC,Nimbus, RML 380Z, RML 480Z)
Newman Software,
Newman College, Genners Lane,
Bartley Green,
Birmingham, B32 3NT.
Tel: 021 476 1181

GROW A PLANT (BBC RML 480Z)
Heinemann Computers in Education,
22 Bedford Square,
London, WC1B 3HH.
Tel: (021) 236 1086
(For software enquiries only).

HOT AIR BALLOON (BBC)
Heinemann Computers in Education

INFORMATION HANDLING PACK
MESU Publications
Hoddle, Doyle & Meadows Ltd.,
Old Mead Road, Elsenham
Bishop's Stortford, Herts, CM22 6JN.
Tel: 0279 813939

INTER-WORD (BBC)
Computer Concepts,
Gaddesden Place, Hemel Hempstead,
Herts, HP2 6EX.
Tel: 0442 63933

JUMBO (BBC, RML 480Z)
MEP Infant and First School Pack
No longer in print.
Should be available via LEA computer adviser.

LITTLE RED RIDING HOOD (BBC)
Selective Software,
64 Brooks Road, Street,
Somerset, BA16 0PP.
Tel: 0458 43079.

LOCKS (BBC)
MAPE Tape 1
Newman Software

MAGIC TELEPHONE (BBC)
Newman Software,
Newman College, Genner's Lane,
Bartley Green,
Birmingham, B32 3NT.
Tel: 021 476 1181

MAKE AND PLAY AN ADVENTURE (BBC)
ESM, Duke Street, Wisbech,
Cambs.,PE13 2AE.
Tel: 0945 63441/443

MALLORY (RML 480Z)
Games, activities and investigations for the primary classroom. Vol. 1 Capital Media, ILECC,
John Ruskin Street,
London, SE5 0PQ.
Tel: 01 735 9123

MALLORY LANGUAGE WORK (BBC)
Capital Media, ILECC,
John Ruskin Street,
London, SE5 0PQ.
Tel: 01 735 9123

MANGON (BBC)
Newman Software,

MARY ROSE
C.S.H. Ltd

MESU/NCET PUBLICATIONS
Hoddle, Doyle & Meadows Ltd.,
Old Mead Road, Elsenham
Bishop's Stortford,
Herts, CM22 6JN.
Tel: 0279 813939

NOTICEBOARD (BBC)
Information handling pack, MESU Publications,

OUR FACTS (BBC RML 480Z and Nimbus)
Information handling pack, MESU Publications,

PENDOWN ADVENTURE WRITER (BBC RML 480Z)
Logotron Ltd.,
Dales Brewery, Gwydir Street,
Cambridge, CB1 2LJ.
Tel: 0223 323656

PIPISTRELLE (BBC)
MESU/NCET Publications

PROMPT/WRITER (BBC)
MESU Publications

SORTING GAME (BBC, Nimbus)
Information Handling Pack
MESU Publications

SPACE WALK (BBC)
Cambridge Micro Software,
Cambridge University Press,
The Edinburgh Building,
Shaftesbury Road,
Cambridge, CB2 2RU.
Tel: 0223 312393

SUPER SEED (BBC)
Cambridge Micro Software,

WORDWISE-PLUS (BBC)
Computer Concepts,
Gaddesden Place,
Hemel Hempstead,
Herts, HP2 6EH.
Tel: 0442 63933

Burglar Bill, Ahlberg,
Janet and Allan Ahlberg,
London: Heinemann, 1977.
ISBN: 0434925004.

Charlie and the chocolate factory,
Dahl, Roald,London: Allen & Unwin, 1967
(1985 printing). ISBN: 004823303X.

Concept keyboard (BBC,RM Machines)

AB European Marketing,
Wharfdale Road, Pentwyn,
Cardiff, S. Glamorgan, CF2 7HB.
Tel: 0222 733485

Data logging

Data logging is the automatic recording, storing and displaying of information received from sensors which react to changes in temperature, light level, etc. The sensors may plug directly into a computer or into an interface. The data received from sensors will be in either **digital** or **analogue** form.

Digital sensors such as simple switches and pressure pads register an ON or OFF state and are mainly used as counters or to trigger other events. For example a pressure pad could be used to count the number of children entering a room over a period of time or to initiate the recording of other information.

Analogue sensors such as temperature and light sensors show a gradual change from minimum to maximum levels and are used to record these changes over time. For example children might record the change in light intensity and temperature in their classroom over a 24 hour period.

Many analogue sensors can also be used in a digital mode. e.g. a light sensor may be used to register *light* or *dark*.

Most analogue interfaces for the BBC Microcomputer accept up to four sensors. Some will also accept two digital sensors.

Measuring with LOGO on the BBC micro.

John Lodge & Ray Lewis.

Measurement.

The role of Logo in the field of primary control is well documented; c.f.Chung 1988, Eyre 1987, Morris 1987. However Logo, by means of its microworld CONTROL LOGO, also enables the BBC micro to be used for measurement.

Measurement is carried out by connecting sensors, via an appropriate buffer box, to the BBC's analogue port. This port is a D-shaped socket situated at the rear of the computer. It will be familiar to many pupils as the 'joystick port'.

CONTROL LOGO has a single command associated with the analogue port. It is the ADVAL primitive. To inspect a sensor reading on channel 2 one types:

PRINT ADVAL (2).

The ADVAL command outputs a number between 0 and 65520; the size of the number depends on the strength of the signal arriving from the sensor.

Therefore, if a light sensor was plugged into the third analogue channel and held up in full sunlight, the instruction PRINT ADVAL (3) would result in a number close to 65520 being shown on the monitor screen. If the same sensor was placed inside a trouser pocket the instruction PRINT ADVAL (3) would display a number close to zero.

Customising.

Although not difficult to use, the ADVAL command is too crude for classroom work, since the large range of values it returns is impractical for young children to handle. We have customised CONTROL LOGO for measurement by creating two procedures. These are SETRANGE and SENSOR.

The SETRANGE procedure takes an input which can be any positive number. It defines the maximum value which the sensors can return. Hence, entering SETRANGE 20 would cause a light sensor in full sunlight to produce a reading of 20 instead of 65520! SETRANGE lets the teacher choose sensor values appropriate to the application and the age of the pupils.

The SENSOR procedure outputs sensor readings; but in the range determined by SETRANGE. It replaces the ADVAL primitive. To see a sensor reading one types

PRINT SENSOR (n) where n = 1 to 4.

A weather project.

To understand how SETRANGE and SENSOR are used, consider a class project where children are using the BBC to collect weather data. Light and temperature sensors are plugged into channels 1 and 2 respectively of the analogue port. The intention is to sample light and temperature levels every 15 minutes over a twenty four hour period. Results are to be printed out on paper.

How can Logo accomplish this?

Here is one way.

1. The printer is initialised by depressing the <ctrl> and <b> keys together.

2. A suitable sensor output range is selected, say, 0 to 100 viz. by typing SETRANGE 100.

3. Samples are taken.

4. Logo waits for 15 minutes.

5. Steps 3 to 4 are repeated 96 (i.e. 24x4) times.

6. The printer is turned off by depressing the <ctrl> and <c> keys together.

A possible procedure for steps 3 & 4 could be:

```
TO SAMPLE
PRINT SENSOR 1 PRINT SENSOR 2
WAIT 54000
END
```

A procedure to execute step 5 could be:

```
TO FULLDAY
REPEAT 96 [SAMPLE]
END
```

Typing the program FULLDAY and pressing the RETURN key would cause the BBC to take light and temperature samples every 15 minutes over a 24 hour period.

Intervals.

Logo uses the WAIT command to freeze the execution of a procedure viz. WAIT 60 produces a one second delay. For time intervals of all but a few seconds, it is clear that large numbers will be generated by the WAIT primitive. To circumvent this problem, we have produced our own delay procedures. These are HOURS, MINUTES and SECONDS. Therefore, to create a delay of 1 hour, 36 minutes and 45 seconds one types:

```
HOURS 1  MINUTES 36  SECONDS 45
```

Using the new delay procedures, the program SAMPLE above can now be re-written in a simpler form:

```
TO SAMPLE
PRINT SENSOR 1 PRINT SENSOR 2
MINUTES 15
END
```

The output of the FULLDAY program above will be a list of numbers printed on both screen and on paper. Note that it is also possible to plot a screen graph of the sensor readings using Logo's turtle graphics (Lodge 1988).

Conclusions.

It has to be admitted that Logo has some significant limitations. It is slow, interrupts procedures periodically to collect garbage, and it doesn't leave enough memory to provide anything more than rudimentary data-analysis software tools. The delay procedures HOURS, MINUTES and SECONDS are consequently only 99.3% accurate. However, despite these restrictions, there are still many worthwhile data-capture applications that junior children can undertake.

We have presented a number of LOGO procedures which allow primary pupils to make programming decisions in a microworld which they recognise and understand. Programming in LOGO puts children fully in charge of their measuring and data-logging experiments. It is our belief that the activity of programming helps develop problem solving skills in the pupils, and provides them with a clearer understanding of the data-capture process itself. To date, little work has been done in the field of primary data-logging but informal evaluation seems to indicate positive benefits for pupils

REFERENCES:

Chung, P. (1988) in Teaching and Learning with Robots. Croom & Helm.

CONTROL LOGO is published by Logotron Ltd., Dales Brewery, Gwydir St., Cambridge.

Eyre, R. (1987). "What is control technology?". Microscope: Logo Special.

Lodge, J. (1988). "Data-Logging in Logo." IT and Learning. Vol. 11 No. 1.

Lodge, J. (1989). "Data-Logging in the Primary School." Computer Education. No.61.

Morris, E. (1987). Children in control. The Advisory Unit.

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ESP

ESP is a simple data-logging program which enables children to look at sensor input on the BBC analogue port and may be used with any 4-channel analogue interface. It also has the facility to sense the state of the two digital inputs and will show the input from the MAPE sensors on channels 1 and 2. Data may be viewed as a number, on a dial or as a line graph.

Please note ESP does NOT give accurate temperature readings; it is designed to allow children to look for patterns and compare relative changes in light, temperature etc over time.

The essential function of ESP is to allow children to record information over a period of time. This may be as short as a few minutes or for up to a month. Of course, since the computer is tied up when this is happening, it is likely that longer recordings will take place over-night or when the school is closed at week-ends or during holidays.

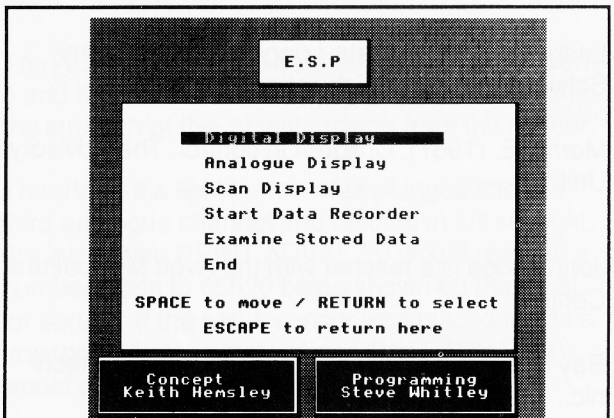
Recording can be set to start at a particular time or when particular conditions are met. Recorded data is saved to disc and may be reviewed graphical form, examined in detail and dumped to a printer.

The sample file

The sample file (stored data) is a recording of three containers of hot water cooling down over a six hour period. One was wrapped in plastic 'bubble' sheeting, one was wrapped in cotton wool and the third had no wrapping.

Starting up

Press SHIFT/BREAK to get the main menu. You are offered 6 options.



Press the SPACE BAR to highlight the option you require and press RETURN to confirm it.

Press '@' to set up ESP to your interface (see 'Setting up digital values')

Press ESCAPE to return to the main menu.

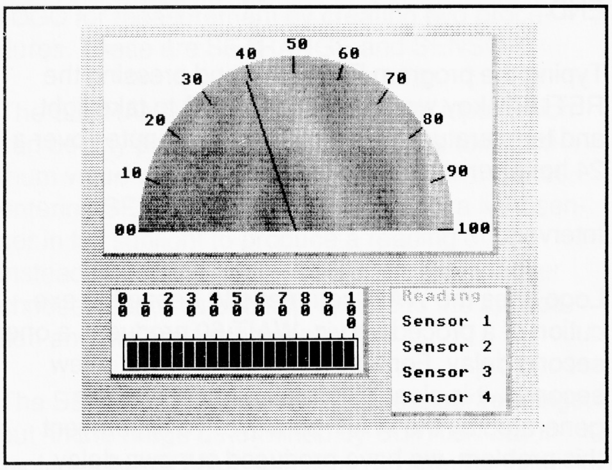
Digital Display

This option displays a digital value for the four channels and indicates whether the 'fire-buttons' are 'on' or 'off'.

The maximum value is generally 99. However some interfaces may produce a higher or lower maximum value. See 'setting up digital values' to configure ESP to your interface.

Analogue Display

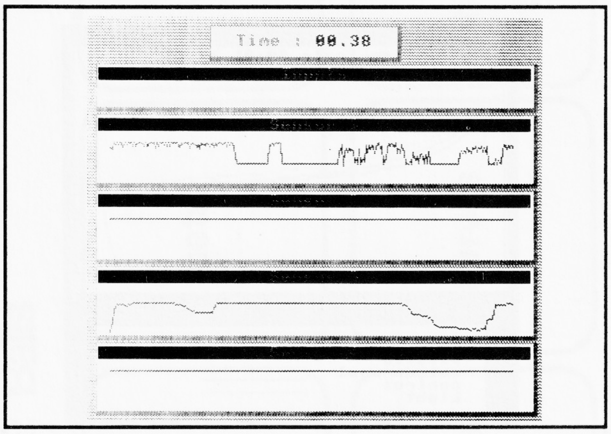
This option displays one channel at a time on a 'dial' and on a graphical display.



The current channel being displayed is shown in the small window at the bottom of the screen. To choose a new channel press the relevant number key .

Scan Display

This option displays all four channels as line graphs. The inputs window shows the state of the 'fire buttons'. The time lapsed in minutes and seconds is shown in the top window.



If you wish to halt the display at any time press the SPACE BAR. To restart the display press the SPACE BAR again. You can obtain a print-out at this stage by pressing CTRL/P.

Start Data Recorder

This option allows you to set up the program to automatically take readings over any length of time from one minute to one month.

When the recording is completed the information will automatically be saved to disk. ESP only stores one data file per disk so if you have some data already saved on your disk this will be replaced. It is therefore advisable to work with a new back-up copy of the disk for each recording you do.

You can specify whether you want the recording to start at a particular time or when either or both the 'fire-buttons' are pressed. (any sensor with 'on' and 'off' states can act as a fire-button; e.g. light/dark, hot/cold or a pressure pad.)

Initially you will need to set the current date and time using the arrow keys to advance or retard the numbers. Press RETURN to confirm each one. To specify the start time use the SPACE BAR to move through the options which are:

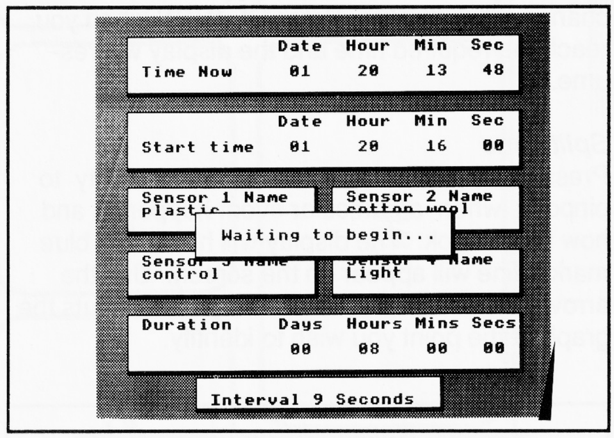
Start When Time is reached
Button 1 is pressed
Button 2 is pressed
Both buttons are pressed
Either button is pressed

Press RETURN to confirm your choice.

If you opt to start at a particular time use the arrow keys to set the start time.

You can then give a label to each sensor you will be using. This is useful for identifying which is which when you read back the data.

Finally you need to set the recording time. This can be from a minimum of one minute to a maximum of a month. Again, use the arrow keys to set the length of time and press RETURN to confirm. You will then be told how often readings will be taken. The minimum amount of time between readings is one second.



A window with the message "Waiting to begin" will then appear and the program will wait for the conditions you have specified.

Examine Stored Data

If you opt to look at the stored data a new menu is displayed. You can now opt to:

Scan all four channels
Examine one channel
Graph all four channels
Return to main menu

Scan all four channels

This option looks like "scan display" but is in fact a faster replay of the recording of all four channels. As the data is scanned the time at which it was recorded is shown in the window at the top of the screen. Use the SPACE BAR to pause the display.

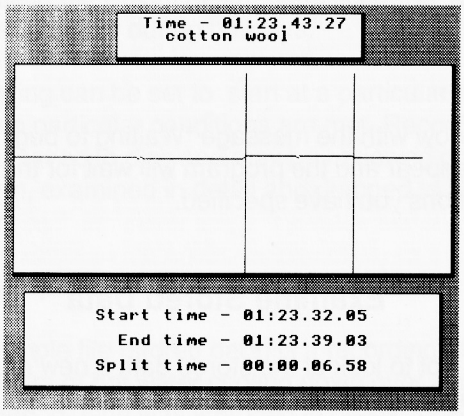
Examine one channel

First enter which channel you wish to examine. You are then shown a graphical scan of one channel in more detail. The window at the top of the screen displays the time of recording and the label you gave to the channel.

Pause
Press the space bar to pause the display and again to continue.

Set time
If you wish to see what happened at a particular time during the recording press "T". The display will halt and you can set the time using the forward and backward arrow keys. Hold down SHIFT and press an arrow key to make the time change more quickly. Press RETURN when you reach the required time and the display will resume.

Split time
Press RETURN to use the split time facility to pinpoint when a particular event happened and how long it took. The display will halt and a blue marker line will appear on the screen. Use the arrow keys to move the marker line until it cuts the graph at the point you wish to identify.

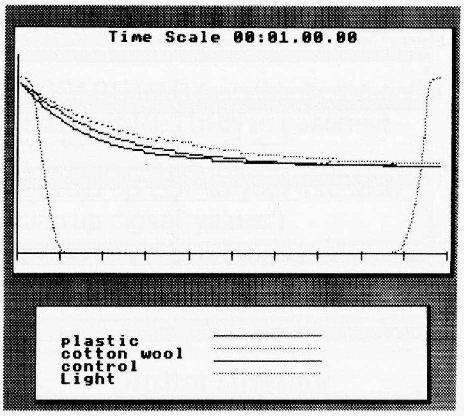


Press RETURN to fix it at this point and another marker line will appear; move it to the required position and press RETURN again to get another time and the interval between the two.

Graph all four channels

You can graph up to four channels. You are first invited to press the number of a channel if you do not want it to be displayed. Press RETURN for the graph.

When the graph has been drawn you can opt to add a vertical scale and extend the vertices. Press CTRL/P for a print-out at this stage.



In order to allow the graph to fit onto one screen this facility does not always use all the data which has been stored; i.e. even though you have recorded every second it might only look at the values for every fifth second. Use the zoom facility to enlarge parts of the graph which are particularly interesting.

Zoom
You can enlarge a part of the graph using the zoom facility. Move the rectangle over the part of the graph you wish to enlarge and press RETURN. (You can make the rectangle larger using the > key).

Setting up digital values

The values shown by ESP are not an accurate measurement of temperature and light etc. Because calibration of sensors is such a complex operation this is not done other than to allow a slight alteration of the maximum value shown.

You can set the maximum numerical value displayed on ESP. Please note that the analogue and digital display screens are set for a maximum value of 99.

To set the values press @ when the first menu is displayed and use the arrow keys to alter the display until all the channels are as near 99 as possible and then press RETURN. The setting will be stored on your disk so you do not need to repeat this unless you are using a different interface.

Keith Hemsley

FILENAME: Balls

is it	does it have	has it got	plastic	wood	metal	fabric
bigger than	smaller than	sponge	glass	spheres	curves	holes
heavier than	lighter than	smooth	rough	pattern	furry	jingle
hollow	shiny	squashy	dirty	soft	hard	

FILENAME: Burglar Bill

baked beans	rusks	ball	take
toothbrush	cocoa	all	drop
nappy	ginger nuts	RETURN	use
West	East	North	South

materials NCET **KEYBOARD OVERLAY** MICRO-SCOPE Science Special

is it	does it have	has it got	can it	bigger than >	thicker than	heavier than	longer than
metal	glass	clay	coloured	smaller than <	thinner than	lighter than	shorter than
wood	plastic	shiny	decorated	smooth	holes	sharp	pointed
hard soft	rusty	dull	pattern	rough	magnetic	transparent translucent	

Word Processing and Primary Science

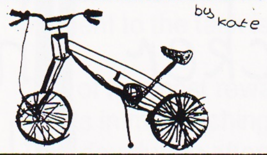
Desk top publishing

The Bemmy Discoverer 30p

October 12th

Class 3R restore Craig's old bike.

Craig was scrapping his old bike so we decided to do it up. Our teacher said we could spend £6 on parts. First we took it all to bits. We put labels on each bit and drew pictures of how they went together. We cleaned each part and rubbed off the rust with wire wool. Mr.Jones sprayed the frame green for us. We bought new brake parts. It was hard putting it all back together and it took a long time. Our classroom looked like a garage. Now it is finished we are using it for lots of different tests. We took a vote and decided to sell the bike before Christmas and give the money to a charity. Helen & Paul.



Brake tests

We tested our bike on lots of different surfaces. We tried using both brakes and just one brake. See page 2 to find out how we did our test and what we found out. Rachel.

Safety checks

See page 3 for Ian's list.

Age: 8/9
Context: Bicycle project
Organisation: Pairs/individuals
Audience: Whole school/parents
Software: FRONT PAGE EXTRA
Other examples: Consumer reports
Unexpected discoveries
Famous scientist's lives
Building environmental areas

Producing labels

February 21st
Growing cress
I put these seeds on dry blotting paper today. I am not going to water them. I don't think they will grow.
Kay

February 21st.
Growing cress.
I put these seeds on wet blotting paper. I am going to make sure they don't get dry. I think my cress will grow well.
Carl

February 21st
Growing cress.
I put my seeds on damp blotting paper in a shoe box. I am not sure if they will grow but I think they will. My mum sometimes grows seeds in the airing cupboard.
Helen

Age: 7/8
Context: Growing cress seeds
Organisation: Individual
Audience: Rest of class
Software: PROMPT/WRITER

Collaborative writing

the recorder has 12 holes . the recorder has a hole to blow in to. the recorder has a pointed top to blow in. the recorder has a has round holes. the recorder has two holes at the ends. it is made of wood and plastic .
Joe, Alison, Richard.

Age: 4/5
Context: Observation work linked to Holes topic
Organisation: Group of 3
Audience: Rest of class/parents
Software: PROMPT/WRITER with Concept Keyboard

March 14th 1989

Dear Sir or Madam,

In Science we have been looking at electronics. In one of our lessons we made a curcuit for Flashing Lamps. It consisted of a breadboard, two transistors, two resistors, two capacitors 100 MF, one battery, four wires and two lamps which we had to make flash alternately. We thought you might be interested in using this circuit for some of your Road-Safety Equipment. We have had few other ideas about how our experiments might be used, like the lights at a Pelican Crossings, Traffic Lights and Warning Lights around road works.

If you would like to come and see one of our working circuits or have us send you any other details you might want to know please contact the School as soon as possible.

Yours faithfully
Jack
Hazel
Wendy

Age: 10/11
Context: Simple electronics work
Organisation: Group of 3
Audience: Electronics company
Software: FOLIO

Individual writing

Age: 7
Context: Winter weather topic
Organisation: Individual
Audience: Self and rest of class
Software: PROMPT/WRITER

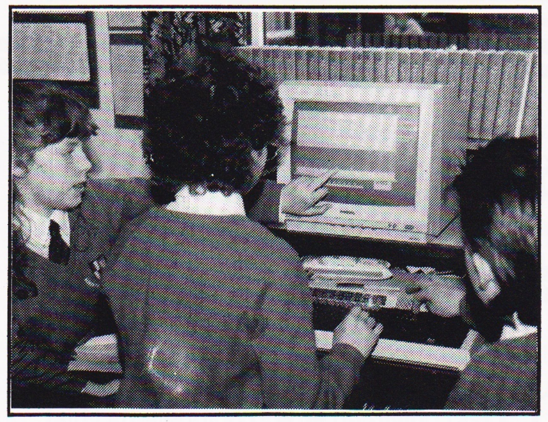
Frosty, cold, chilly,
Crackly ice.
Water and ice.
Frosty on trees and roof tops.
Slidey and wet, you skid on it.
Crackly and white,
Crystals transparent and shiney.

Daniel

Age: 6/7
Context: Part of Water topic
Organisation: Individual
Audience: Self/rest of class
Software: PROMPT/WRITER
Other examples: Keeping notes of a long term project

DROPPING DYE

When I dropped the dye it landed in a circle and each time I dropped it from a higher place it got bigger and some times the circle had little spikes coming out of them.
Toby



Electronic mail

Age: 9/10
Context: Butterfly survey
Organisation: Pair
Audience: Unknown - the world!
Software: TTNS
Other examples Sharing findings.
Collecting data from different places.
Comparing results.

Noticeboards, Free text

Age: 10
Context: On-going work in school garden
Organisation: Individual
Audience: Self and rest of class
Software: NOTICEBOARD
Other examples:
On-going projects such as growth of babies or gerbils.
Seasonal changes to tree/environmental area etc. Results of investigations into household materials. Recording children's existing ideas about how things work. Presenting challenges/problems/for others to tackle.

NOTICE NUMBER: 59

6th April. Today I planted rows of radishes, carrots and lettuce. I made 3 drills 15cm apart and sowed the seeds thinly and covered them lightly with soil. Hopefully the radishes will start to grow in about 2 weeks.

KEYWORDS:
CARROT, LETTUCE, RADISH, SEED.

NCET

MICROS AND PRIMARY EDUCATION