

Special keyboards for special needs

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This paper stresses the importance of good design at the child-computer interface. The Concept Keyboard is discussed as an example of a useful input device. It has a touch-sensitive surface overlaid by a rectangular sheet of paper. This "overlay" may be designed to meet the requirements of each individual program. Examples are given of various applications, including a project in which the Concept Keyboard has been used to develop the curriculum in environmental studies for children with moderate learning difficulties. Nature walks in various environments are simulated and the computer is integrated with other indoor and outdoor resources.

The child-computer interface

If a group of educational technologists were to start today and design from a scratch a microprocessor-based aid for very young or educationally handicapped children, it is most unlikely that they would employ the QWERTY keyboard. Yet in the second half of the 1980s this historic device remains the most common input medium for microcomputers in schools.

A simplified analysis of the development of computing in general and of educational computing in particular, may identify three phases in which the main advances have been, in chronological order, in the fields of:

- hardware,
- software,
- the user-interface.

Whilst it is true that general progress in computing has been concerned with all three of these areas, the main concern of the first generation was to build machines of adequate computing power. The next phase was characterised by developing software to exploit this computing power. We are now entering the phase where the scope and extent of both hardware and software has increased tremendously and more attention is being focused on how the human user relates to such systems. In the present paper we are concerned with the design of the child-computer interface.

In some early applications using the QWERTY keyboard as input device, the task of finding and depressing the correct keys presented more problems to the handicapped user than the educational objective itself. This made life particularly difficult for children with certain types of special needs, such as those with poor motor control or slow learners. The QWERTY keyboard did not help or invite the child to use it. Instead it often initiated fear and required training or practice before it could be used efficiently.

More recently alternative input devices have been developed such as the touch-sensitive screen, the mouse, the light pen and the Concept Keyboard (Brown, 1985a).

The concept keyboard

The Concept Keyboard is a particularly useful input device. It allows the user to select the keyboard layout best suited to the required application. It consists of a flat touch-sensitive polycarbonate surface (A2, A3 or A4 size) made up of 128 or 256 cells set out in a rectangular array. Although the board is completely smooth, each one of the touch cells sends a unique signal to the computer via a connecting lead. Any or all of these outputs are available for use by a controlling program. The potential of the Concept Keyboard is generally better exploited, however, not by assigning each of the touch cells to give a separate response; instead groups of cells may be connected logically into *response areas* so that a touch anywhere within one area will give the same response. The response areas are identified on a sheet of paper or thin card which exactly fits over the board. The overlay might display pictures, words, colours, a map ... the list is endless. The program designer can select the most suitable format for the current application. Examples are shown in figures 1 and 2.

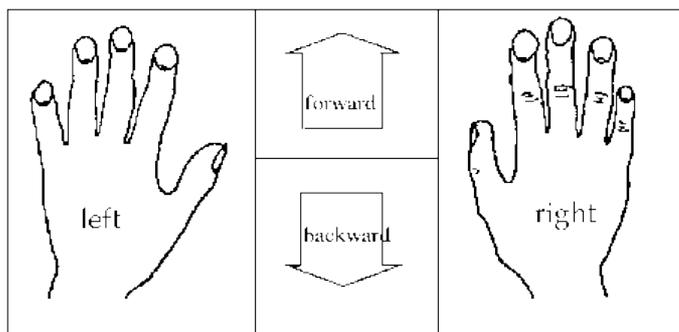


Figure 1: Overlay for simplified Logo

Just as the computer's communication to the user is no longer restricted to text on the screen, but employs exciting and colourful graphics; so the Concept Keyboard user can reply not only by means of text but by touching overlays which might include such items as pictures of animals, musical notes, the words of a reading scheme, diagrams or coloured shapes.

£1	50p	20p	10p
5p	2p	1p	READY
			MISTAKE

Figure 2: Overlay for money program

The traditional flow of information between a human and a microcomputer system was as shown in figure 3. The human user sent information via the keyboard to the central processing unit. After doing its work, the microprocessor sent information to the user via the screen. With the arrival of the Concept Keyboard an important new link is introduced into the chain. The Concept Keyboard *conveys* information to the user. Information about the program is supplied to the user by the overlays as well as the VDU screen (figure 4).

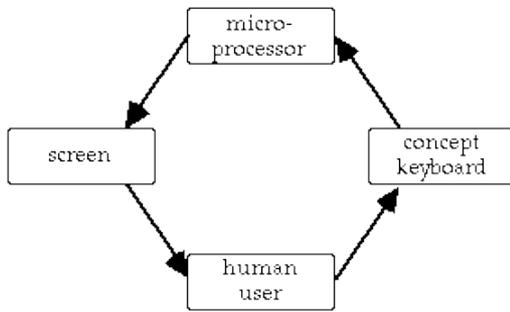


Figure 3

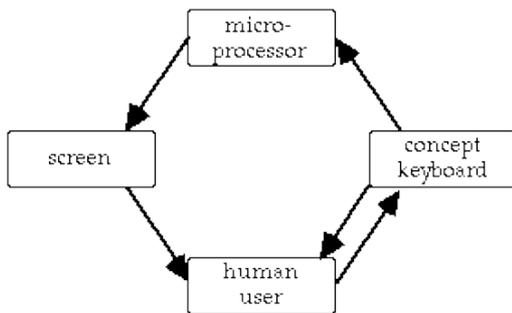


Figure 4

With light pens and touch-sensitive screens it is now possible to communicate with the microprocessor via the screen. The keyboard, whether Concept or conventional, can receive messages from the microprocessor (to cause red lights to shine or bleeps to be emitted). Thus the circle of two-way communication is complete (Figure 5).

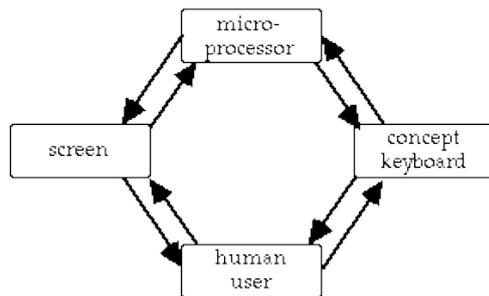


Figure 5

It has been shown (Brown, 1985b) that the Concept Keyboard program designer should not only use the board as an input device, but also as a means of informing the user about the program. This will mean in practice that the child will not spend long periods of time staring at a screen. Instead messages from the screen will be related to information on the Concept Keyboard and vice-versa.

From an ergonomic point of view it is undesirable for a child to sit still at a work station for extensive periods of time. The situation is considerably improved if the time spent looking at the screen is punctuated by the activity of receiving information from the Concept Keyboard and making a considered response back to it. The latter may be implemented by pressing a particular part of the board or by moving an object across it. Typically, the object may be a pawn, button or counter to mark the user's position, for example, on a simulated walk.

Nevertheless, even by using Concept Keyboard in this way the child is still sedentary and his physical activity is confined to interaction with the computer and its peripheral devices. Experience has shown that it is educationally desirable for periods of activity at the computer to be interspersed with sessions handling natural everyday objects. Creativity is enhanced if the child is stimulated in a variety of ways. An example will now be given of a development in which the computer is integrated with other classroom resources in a learning package.

The computer and environmental studies

Environmental studies has been taken as a classic example of a subject area which, by definition, is characterised by outdoor activity. Nevertheless it has been shown that computer based packages can enhance the environmental studies curriculum. It cannot be over-emphasised that staring at a screen is directly counter to the spirit of environmental studies. Let the child go out into the field ... touch, handle, do, record. There is no substitute for experiencing

mud, getting drenched by rain and feeling blisters! What is the justification, then, for the use of a software package?

Firstly, the computer can provide simulations of excursions into other environments. For most children it will not be part of every day experience to explore a wide range of environments. For schools in an inner city, visits to the sea will be the subject of occasional outings. For country children, visits to the town will be special occasions. Children with special needs may suffer particular restrictions upon their ability to enjoy a variety of environments.

Secondly, the programs can provide preparatory or follow-up material to the actual outdoor activity. They are ancillary to, but no substitute for, the real thing! They should stimulate and motivate children by encouraging them to be more aware of the outdoor environment: to think about the subjects of their observations and be more informed about them.

Thirdly, the package should not merely keep the child staring at a screen, but can offer a variety of stimulating activities within the classroom.

Description of nature walks package

The project produced three packages. Each simulates *nature walk* in one of three environments; the country, the town, the seaside. The target age group was six to eight year olds or older children with moderate learning difficulties. Each *walk* takes place on the Concept Keyboard; the child moves a small counter or button across the overlay which depicts an aerial view of one of the three environments (see Figures 6 to 8). The counter represents the child's position. For example he may be walking along a road, entering a park or climbing down onto a beach. He must walk one step at a time as in real life. The computer will notice if he cheats by jumping, say, from one side of a town to another. The screen will show what he has tried to do and from where he must continue. The child's task is to collect ten objects of interest. They cannot be seen on the overlay but are hidden in the places where one might expect to find them. For example, a crab may be under a rock, an apple may be under a tree.

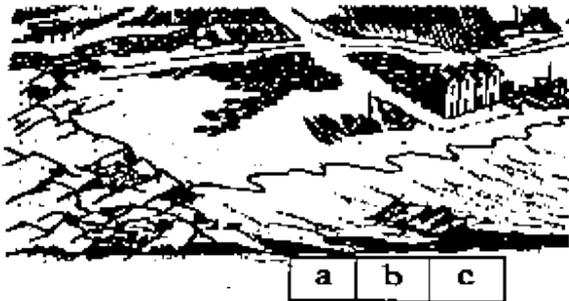


Figure 6: Overlay for seaside walk simulation

While the *walk* progresses the screen provides a graphics display of a little man walking along. Left or right movements to the Concept Keyboard generate corresponding movements of this little man against a background

depicting the appropriate environment. This screen display represents the stage when a child is out walking happily without spotting anything very special. Then suddenly he finds something! The screen display changes to a picture of the object he has discovered.

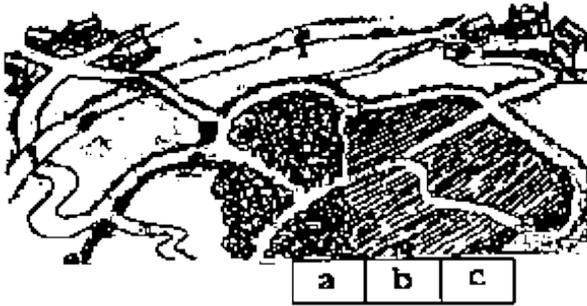


Figure 7: Overlay for country walk simulation

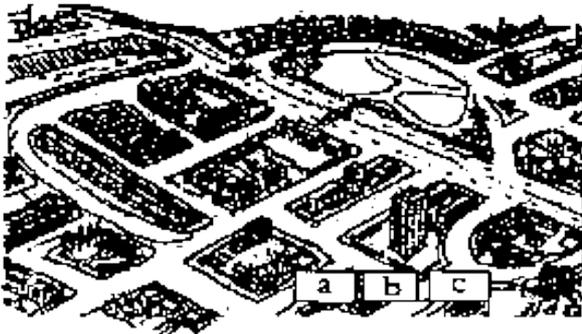


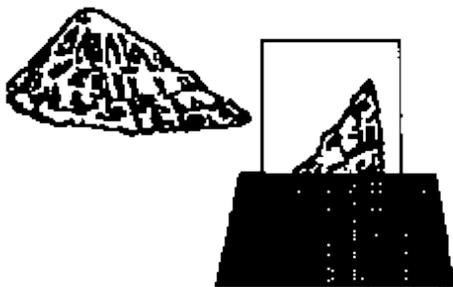
Figure 8: Overlay for town walk simulation

The child must now go to a box, quite separate from the computer, in which there are initially ten picture cards. Each card has a drawing which exactly matches the computer screen's representation of one of the ten objects. The child searches for the right one; he then picks up a special book which contains matching pictures of the ten objects. He finds the right one and then reads the passage beside the picture. (An example of a page layout is given in figure 9). He then returns to the computer and reads from the screen a simple multiple-choice statement. Response is made via the Concept Keyboard. If the child gets it wrong he returns the card to the box and carries on walking. If he gets it right, he may put the card into a slot provided beside the picture in the book. These slots are in the form of bags appropriate for use in the current environment: beach bags for the seaside, hold-alls for the town and knapsacks for the country.

The teacher may, by interrupting the program at any stage, check which objects should be in the bag-slots. The screen will display, for each object, whether it has been found, whether the question has been answered correctly and how many wrong attempts, if any, have been made.

The child is stimulated by the excitement of anticipating the next "find" and the desire to collect a complete set of ten cards. No two uses of the program are the same because the objects are hidden in certain places with a probability defined in the program. So no two walks, even over the same route, will produce all the same finds in the same places.

When the walk is over and all objects have been collected, the child is encouraged to choose a follow-up activity relating to any of the objects. For this purpose a book of suggestions for teachers is supplied with each package. At this point the computer activity stimulates the child to go out of doors and collect real objects, classify and compare them, bring them into the classroom and carry out experiments, observations and do art work. For example, after finding the feather on the country walk the child may be encouraged to go out and collect real feathers, classify them by colour and size, relate the size of feathers to the size of the birds, their eggs, their nests, their wingspan. Activities include collecting pictures of birds and learning to recognise them, attracting birds to a feeding table outside the classroom. Artwork suggested by a feather includes making a quill pen, painting with a feather or designing an Indian headdress.



LIMPET SHELL

The limpet is like a snail except that lives near the sea not on land. It feeds on young seaweed. As the tide goes out it returns to its home spot and grips the rock tightly with its foot. This is why limpets never seem to move.

FOSSIL

A fossil is the remains of a once living plant or animal that has been turned into a stone. The plant or animal died perhaps thousands of years ago. It has been buried under the ground for a very long time and has become hard. This fossil is called an ammonite.

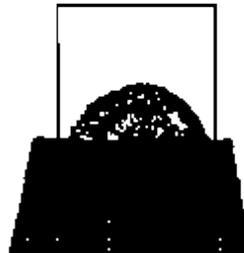


Figure 9: Page layout for seaside package

The computer, then, should be seen not as an attraction in itself, holding a child indoors with its artificial simulations, however realistic they may be. Instead the computer should give encouragement and support to actual outdoor activities which enrich the child's awareness of the variety of living things and materials in the environment. Thus the child will come to

appreciate the structure and form of living things and their products. It should develop the child's ability to use books and other media further ideas and information.

Special needs

For the child with special needs who is physically prevented from exploring and enjoying the outdoor environment, a computer package with support materials is ideal for obvious reasons. Some of the thrills of walking over countryside or by the sea are brought to the desk top.

Slow learners and other children with moderate learning difficulties find this multi-media approach helpful. Concentration levels are significantly increased when using packages like those described here. The continuous use of the screen can become tiring. However in the package described, the scene of the action changes repeatedly between the screen, the Concept Keyboard, the book, the box of picture cards and finally the follow-up activity.

References

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Acknowledgments

The project discussed in this paper was sponsored by the Council for Educational Technology, UK, through the British Government's Microelectronics Education Programme (Project No. 297). Thanks are expressed to their representative Mrs Audrey Milner, Curriculum Development Manager, Mr Tom Au, Programmer, City of London Polytechnic, and Mr Ralph Dunkley, also of City of London Polytechnic who was responsible for the artwork and the layout of the documentation. Thanks are also due to Mrs Marion Brown, Headmistress, Woodlea School, Woldingham, Surrey, who made many helpful suggestions and was responsible for the schools trials.

Based on a paper presented at EdTech'86, International Educational Technology Conference and Exhibition, University of Western Australia, Perth, 2-5 December 1986.

Please cite as: Brown, I. C. (1987). Special keyboards for special needs. *Australian Journal of Educational Technology*, 3(1), 67-74.
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