ARTIFICIAL INTELLIGENCE IN THE CLASSROOM

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ABSTRACT

Various teaching strategies have been employed in attempting to overcome the difficulties experienced by students learning computer programming on courses held at the Bedford College of Higher Education,England.

The problem remains unsolved; the main difficulty encountered lies in the development of the algorithm, not in the syntax or semantics of the language. The contribution gained by the use of flowcharts has been negligible; the major contribution came from allowing the students to work in groups.

The essay follows the argument that, accepting the premise that programming requires logical thinking, a solution to this problem may be forthcoming if it is tackled by helping these students to develop problem solving skills from an early age; thereby placing the onus on the schoolteacher.

Use of educational tools, namely BIGTRAK, initially for the very young, followed by the TURTLE with LOGO programming, and latterly microProlog is advocated.

The paper is introduced by a brief discourse on the concept of knowledge, in order to confirm that to teach thinking is difficult, and hence that there is a role for some aspect of artificial intelligence in the classroom.

By definition, a teacher's role in the classroom must be that of one who teaches, imparting knowledge and guiding the studies of the pupils. But, the concept of knowledge is difficult to define and cannot be determined precisely in the way that some words can. In attempting to define the constituents of the concept of knowledge, various notions can be considered, for example: information, instruction, enlightenment, learning, or practical skills.

Attempts have been made to break knowledge into divisions, Hirst,(1973) put forward the suggestion that knowledge was separable into distinct forms, such as mathematics, physical sciences etc. But, if these forms are accepted then the concept of a particular branch of knowledge may even differ, depending on how it is presented. Polya,(1973) states, "Mathematics presented in the Euclidean way appears as a systematic deductive science, but mathematics in the making appears as an experimental inductive science."

The view that the four ways of thought: logical, empirical, moral, and aesthetic represent more fundamental divisions of knowledge, Philips,(1971) perhaps relates more closely to the aim of including more of the cognitive aspects of teaching in the classroom.

While the claim that knowledge is worthwhile on its own account, simply for the development of the mind, can be appreciated, as Cribble (1969) argues, forms of drill are not intrinsically worthwhile. And while this form of teaching perhaps cannot entirely be dispensed with, the question often arises relating to whether teachers actually teach children to think, i.e. to develop their ability for reasoning, experimenting, making moral reflection, or to achieve an appreciation of aesthetic principles. The knowledge that is planted in a child has to be brought into action.

Landa (1979) considers that some teachers do teach children to think but that some do not. He admits that to teach thinking is a problem, because the operations that have to be carried out on the knowledge present in the student's head, in order to be able to problem solve are not well developed.

The assertion that organised teaching is not required for learning to take place, is held by Papert (1980), who puts forward the analogy of how a child learns to talk.

The difficulty of teaching children to think then is evident, and while the computer can be a catalysing agent for promoting a different type of teaching to take place in the classroom, to-date the methods employed in computer-aided-learning, have on the whole, contributed little to further the pursuit to help children to think. Computer-aided learning techniques employed in schools generally follow the traditional method of classroom teaching, and if a child's development partially depends on this traditional approach to teaching, then present computer-aided-learning does seem to provide motivation and have a novelty value, albeit, possibly a temporary innovation.

But, Paperfs (1980) association of this use of a computer for drill and practice,(combined with the use of the BASIC language), with that of the QWERTY keyboard, exemplifies the dangers imminent when tradition takes a firm hold, and the ensuing difficulty encountered when endeavouring to bring about any change; in this case in the way that computers are used in the classroom.

Intelligent tutoring systems cater for the student more adequately, and aid research into learning, but are rarely found in schools. Also artificial intelligence programs which deal with aspects of human behaviour designed to simulate behaviour help to illuminate how children think.

In the classroom, a simple machine in the form of a toy tank, BIGTRAK, can be used by primary and infant teachers for mathematics teaching and to involve the children in logical thinking, besides providing an introduction to computer techniques. The tank can be programmed to move, turn, pause or fire and the children can think of their own problems and also how to solve them, and hence program the tank. They often act as BIGTRAK themselves in finding out the required movements, then logically assemble them to produce the program of instructions, which importantly, they realise may not be correct at the first trial. Hence, this toy enables a means of pupil-controlled investigation to take place, besides providing a by-product of introducing measurement and direction to them. The guidance of the teacher is required, as without this its value would diminish.

BIGTRAK then forms a medium for Papert's ideas,(1980) although a rather unrefined tool in some respects, learning is achieved through its use without formal teaching, and its advantage in schools lies in its comparative cheapness.

The object that Papert(1980) advocates for use with children, the TURTLE, has a cost disadvantage at present, but with the infiltration of the microcomputer in all schools in Britain, the concept of it, as an educational tool in the classroom, is rapidly gaining acceptance, even though many schools have to be content with "turtle" graphics on the screen, and it is expected that the cost will be lowered. But, even with "turtle" graphics, the child is in control and observations show that they usually enact the steps required to solve their particular problem.

The program language incorporating the use of the TURTLE, LOGO, evolved for applications by children by Feurzeig et al.(1969). The full version of LOGO provides additional facilities to the usual high level language, for example, list processing and recursive functions. But, in many schools in Britain only a subset of the language is in use which relate only to controlling the screen "turtle". This reduces the amount of storage required and the cost of the software. Programs are also written in BASIC which can provide a reasonably successful LOGO environment in the classroom.

While many school teachers in Britain are just beginning to be introduced to the potential of the use of LOGO as an educational tool, possibly because it was devised for such a purpose, a reasonable amount of research and evaluation has been carried out.

Preliminary observations in primary schools in Bedfordshire have revealed keen interest by both teachers and children in its use. The teachers have been impressed by the strategic skills shown by many of their pupils.

In their Evaluation Study: Teaching Mathematics through LOGO Programming,(Howe et al. 1980), the conclusion reached is that the understanding of mathematics by children who are less able can be improved by such programming-based activities.

An investigation into the claims made for the use of the TURTLE in the classroom, involving 15 special schools situated over a wide area of England and Wales terminates in July 1983. The research is co-ordinated by the Chiltern Advisory Unit, Hatfield, England; the final evaluation report should help teachers in deciding the contribution that the TURTLE can make to the development of children.

While it has been shown that girls generally do not achieve as high results as boys in computer studies, the opinion is emerging that they do marginally better than the boys when LOGO is used.

But, it is not only children who can benefit from using LOGO, du Boulay (1978) showed that student teachers who experienced difficulty with certain areas in mathematics gained a better understanding by writing LOGO programs to investigate the topics.

LOGO is used in British and American schools and developments in France, to ascertain its potential for use as an intrinsic part of their educational system, are taking place.

PROLOG-PROgramming in LOGic, designed by Colmerauer and colleagues in 1972, images human reasoning and utilises natural language. Papert enthusiasts support the use of PROLOG for children; a close relationship exists between LOGO and PROLOG.

PROLOG is now being made available for microcomputer systems in the form of microProlog, developed by Mc Cabe 1980. Relatively little work has been carried out on its use in the classroom, but, a project has been running since October 1981, "Logic as a Computer Language for Children", based at Imperial College, London. Evaluation is being conducted in a number of schools and colleges, and courses are being held for teachers in various parts of England.

This project is led by Robert Kowalski who considers that microProlog contributes to promoting logical thinking for use throughout the school curriculum and that it can stand as a subject on its own. He considers that because it is not tied to a particular machine structure, it. is more suitable for use by children than languages which are.(Ennels,1983).

Ennels (1983) has expressed surprise at the quickness that children are learning microProlog. The pupils build their own database and formulate queries, so promoting clear thinking and expresssion.

These then are some of the tools that can be used in assisting teachers to teach children to think; many other micro-technology aids are available and although many are considered to be simply computer toys, an investigation into their potential use in the classroom may reveal that some are more than toys. "Computer toys come closer to imitating the style of human intelligence than the teaching machines of the past and may well represent the educational wave of the future." (Gardner,1979).

In conclusion, the educational tools suggested for use in this paper are mainly just being introduced to schools in the Bedfordshire area, hence it will be some time before there can be any evidence to show that the children's capacity for clear thinking has improved and as a result the difficulties experienced by the ones who may eventually wish to include further computer programming as part, of their future studies may be lessened. Current research in this area suggests that this will be *so.*

REFERENCES

(1) Hirst,P.H. ,Liberal Education and the Nature of Knowledge, in Peters,R.S.(Ed.). The Philosophy of Education, Oxford University Press.(1973).
(2) Polya,G.,How to Solve It. p.117, New York:Doubleday,(1957).
(3) Philips,D.C.,The Distinguishing Features of Forms of Knowledge, in Education, Philosophy and Theory. Vol.3,No.2.(1971).
(4) Gribble,J., An Introduction to the Philosophy of Education. Allyn & Baker. (1970).
(5) Landa,L., Algo-Heuristic Approach to Thinking and Learning: Does CAL Teach Thinking, in Proceedings CAL79 Symposium, University of Exeter, (1979).
(6) Papert,S., Mindstorms Children, Computers, and Powerful Ideas. Harvester Press. (1980).
(7) Feurzeig,W., Papert,S., Bloom,M., Grant,R. and Solomon,C.(1969). Programming languages as a conceptual framework for teaching mathematics. Report No. 1889. Bolt Beranek and Newman, Cambridge, Massachusetts.
(8) Howe,J.A.M., 0'Shea,T., and Plane,F. Teaching Mathematics through LOGO Programming: An Evaluation Study in Computer Assisted Learning, Lewis/Tagg, eds. North-Holland Publishing IFIP.(1980).
(9) du Boulay,J.B.H., Learning Primary Mathematics Through Computer Programming. Ph.D. Dissertation, Department of Artificial Intelligence, University of Edinburgh. (1978).
(10) Ennels,R., Beginning micro-PROLOG. Ellis Horwood. (1983).
(11) Gardner,H., Harvard Graduate School of Education, Psychology Today, p.93, November 1979.