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Microelectronics in education

In recent years, microelectronic technology has begun to have a significant impact on Our primary and secondary educational systems. Schools operate within very low cost budgets for each pupil and there is a threshold above which any technology is too expensive and little used. In the past five years, classical educational technologies such as writing paper and books have drifted upwards in cost approaching this threshold from below, whilst modern microelectronic technology has drifted downwards in cost approaching it from above. During the coming decade these trend lines will cross over and what is now experimental and innovative will become routine. This issue presents a broad spectrum of material that illustrates a range of potential effects of microelectronics on education. All of the papers are based on actual experience rather than speculation, but they are forward-looking in their discussion and implications.

The title of the issue is deliberately *microelectronics* rather than *microcomputers*. Surely the computer in the classroom is an important aspect of the impact of microelectronics in education, and nearly all electronic equipment will contain a microprocessor somewhere within it. However, the trend that is occurring is not only one of classical computer studies being promoted in schools. In particular, numerical data processing has only a minor role to play in the widespread application of the new technology across the curriculum. It is very much the new technology that surrounds the microcomputer and gives it rich communications with the real world that is of key significance in the educational environment: pictorial presentation of teaching material through low-cost colour graphic displays; measurement and control of laboratory and domestic equipment; voice output of a quality suitable for language learning; audio output that can be used to create musical sounds; low-cost storage media that can give access to library materials; ease of text processing and production; and so on—all of these are of at least equal significance to any computational power that is available.

The increasing impact of microelectronics in the home is very significant for its use in schools. The educational system is a microcosm of the real world but often lags behind it. Radio, the gramophone, tape recorders, television, video tape recorders, video games and now the personal computer are part of everyday life and many home environments. Our students are surrounded by microelectronic technology and accept it automatically with little of the resistance of adults. There has been much debate about the educational impact of world events having become spectator activities through television with remote and local violence being presented in the home. There probably should be similar consideration of the impact of *Adventure* games for personal computers in which the basic rules being learnt are "if you see something kill it before it kills you". More recent elaborations of such games have followed the lead of *Dragons and Dungeons* in introducing moral dynamics such that if you attack merchants rather than trading with them your own *alignment* is gradually changed until thieves side with you and ordinary people attack you. Perhaps we should not read too much into the moral education to be obtained from such programs but they are a modern equivalent of the novel, capable of having an even greater impact through the true participation and personal involvement possible.

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The papers in this issue address the questions of microelectronics in the education system in general, the actual and possible uses of videotex for education, the potential of microelectronics for the disabled, and its impact on skills training, computer assisted learning and simulation.

The first three papers arise from educational initiatives in the U.K. undertaken by the Council for Educational Technology (CET), whose staff have been very involved with the development of microelectronics in schools, notably the recently established Microelectronics Education Programme. Leslie Gilbert, Assistant Director of the CET, starts this special issue by detailing some of this work and placing it in a new social context of learning. Vincent Thompson reports a one-year trial of PRESTEL, British Telecom's computerized information service, as a teaching/learning resource in schools; and Jill Coates reviews experiments to provide and use telesoftware materials for the distribution of educational computer programs via teletext and videotex systems.

The following two papers are specifically concerned with the provision of improved facilities for the disabled. Staisey, Tombaugh & Dillon discuss the needs of different categories of handicapped people and show how the power of a computer can be made available through videotex systems to those people both at home and in hospital. Phil Odor extends the discussion of these needs to the education of handicapped children and concludes that mass-production of learning aids is now probably cost-effective. Both these papers call for more effort in this area—to provide the facilities which the technology makes possible.

Terrell & Linyard concentrate, in their presentation, on the evaluation of commercial microelectronic learning aids for young children, reporting a study carried out in schools with a more flexible design than the traditional methods which seem to be inappropriate in a working environment. Pask follows with an historical review of a skills training aid and discusses the advantages of recent microcomputer developments. Shaw & Gaines describe a method for modelling the teacher, learner and the learning process through computer elicitation of the changing construct systems of those involved.

The next two papers are from the Software Concepts Group at Xerox PARC, and both show the use of the Smalltalk programming system. Whilst the technology involved is currently expensive it can be seen as a foretaste of the next generation of low-cost microcomputers. Stephen Weyer discusses the design and use of dynamic books which are used to provide electronic transformations of information to enhance our abilities to search for and access specific or general items of information. Gould & Finzer look at how animation can be used to teach complex time–rate–distance problems, and describe the piloting of the system with non-numerate students.

Hartley & Bostrom present the results of a study using packages in Mathematics, Physical, Biological and Social Sciences in several schools in the U.K. They identify the uses of these materials in the classroom, and hence the desirable attributes of such software. Mills & Stonier complete the issue by considering the future use of microcomputers in education. They forecast "a genuine revolution in education, probably the most significant one in the last hundred years".

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