CHAPTER TWO
INTRODUCTION & DEFINITION OF TERMS

The development of the electronic computer and computer-based systems for use in business , industry and, now, in education has been extremely rapid. The first computers appeared around the end of World War II (Hugo, 1981) and, during the ensuing 35 years, the advances made in the technical aspects of computing have been startling. A full knowledge of these technical advances is not required in order to make sense of the history and present status of educational computing; three simple facts concern us most - computers have become very much more powerful, much smaller and considerably less expensive. It is a combination of these facts that has brought us, within just the last year or two, to the point at which computers and educational computing (taken in this study to mean the use of computers by students, teachers or support staff in any way that influences the curriculum) show signs of becoming significant features of education on a large scale.

> "Some call it a revolution, or a quantum leap, or a major innovation. Others say 'It's just another fad', or, 'We'll never be able to afford it', or, 'Just wait, it'll go away'. The 'it' is the explosion of the microcomputer onto the educational scene." (Gleason,1981)

The concept of computer-based education is not new. On both sides of the Atlantic, as well as in the Soviet Union, there has been considerable study and development of the use of the computer as an educational tool, extending over a period of almost thirty years and consisting of three distinct phases. The following summary of that history of development will take the opportunity to establish a number of terms commonly used in educational computing. The terms will then be used, withour further reference, throughout the study. During the first phase, educational interest in the computer came in two forms. First, there was a narrow technical interest in the computing equipment itself. This prompted a small number of teachers, mainly dedicated mathematicians, to establish the first computer studies courses. Secondly, and far more prevalent in North America than here, was an interest in the computer as a teacher substitute which involved the development of automated programmed instruction techniques for the simultaneous tutoring of large numbers of students individually.

The present development of the technical, computer science, approach to computer education can be seen as a continuation, albeit on a much expanded scale, of the approach established in the early years. Whilst this represents a most important development in its own right, the field of computer science parallels many other areas of technological education. Its promotion is largely non-controversial and the issues involved in its teaching are straightforward - apart from the particular financial and logistic problems of providing adequate 'hands-on' practical facilities. Even now, the number of students needing to be trained as specialist technicians/technologists in this area is relatively small. Accordingly, learning ABOUT computers, as opposed to learning THROUGH computers, represents a secondary focus only of this study, as it does in the current debate over the future of educational computing. Computer assisted instruction (CAI) was often seen in the early days as an educational technology that could be used right across the various age, ability and subject ranges of schools and colleges. In the USA, a number of computer assisted instruction developments were initiated and supported by significant levels of funding from national agencies and various institutions. These set about exploring the ways in which computers could be used in education and training. Early practice has subsequently attracted a good deal of comment, some of it highly critical (Oettinger 1969). There has been a considerable shift over the years in the way educators view the learning process, and early CAI approaches to learning seem naive today. Nevertheless, they represent our most extensive experience in educational computing and much can be learned from them, even from their failings.

During the second phase, which coincided with the 1970s more or less, attention focussed on those areas of educational computing which have become known as computer assisted learning (CAL) and computer managed learning (CML). A fuller treatment of these forms will be undertaken in Chapter 3, so, for the present, suffice it to point out that both represent a departure from the concept of tutorial dialogue used by early CAI. The term CAL is used to define those less constraining forms of machine-student interaction that, through simulations and the provision of calculating power for the student, provide some enrichment of the student's learning experience rather than simply replace the teacher. In CML, unlike CAL, the 'content' of instruction no longer resides inside the computer. Instead, such systems provide guidance, on the basis of tests they administer to the students, through the use of learning resource external to the machine - these may be books or other printed materials, audiovisual aids or other computer-based programs. Or, alternatively, some variants of the CML idea may simply exist to

> "... relieve the teacher or trainer of various tedious and time consuming management tasks and so leave him with more time to devote to the essence of teaching.
>
> The computer is therefore cast in a background, supportive role in which it helps to manage, rather than to provide, learning opportunities." (Rushby,1979)

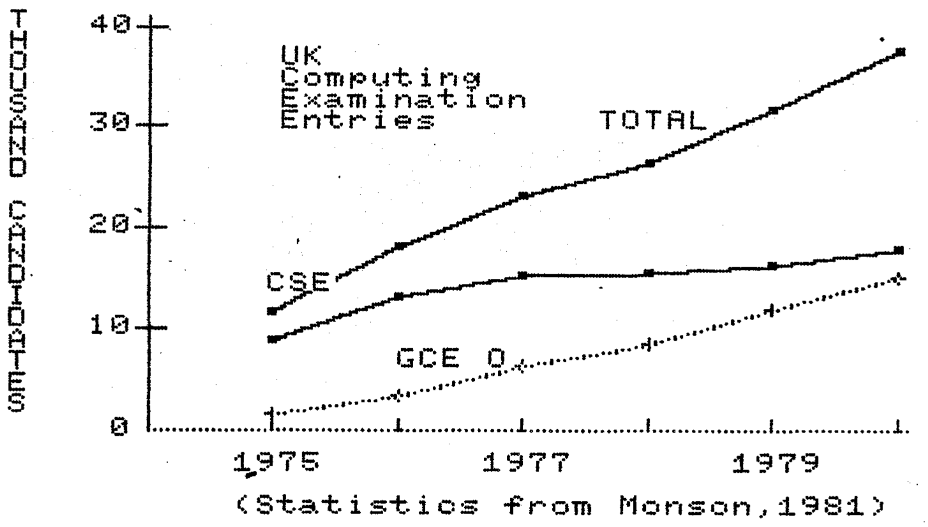
It was during this phase that the first real efforts were made to develop such CAL and CML programmes. The well known PLATO (Programmed Logic for Automatic Teaching Operators) system reached the implementation stages as a result of work done at the University of Illinois. In the UK some independent institutional initiatives were used as the starting point for two national projects - the National Development Programme for Computer Assisted Learning (NDPCAL) and the Schools Council Computers in the Curriculum Project. These UK projects are fascinating objects for study, not only for their approach to educational computing itself, but also as case studies of curriculum innovation and dissemination. They will be examined in some depth in Chapter 5. It is important to recognise that, whilst much of the work carried out by these projects is still of considerable interest today, it nevertheless falls clearly into the second of the three phases referred to earlier. All the NDPCAL work, and the bulk of the Computers in the Curriculum development, took place at a time when the actual computing equipment was bulky, expensive and rare! The whole philosophy of the UK projects was built around the use of remote terminals linked to some large computer, probably housed in a university or in County Hall. Much of the approach to educational computing that this situation spawned is no longer appropriate.

Phase Three of development arrived with the introduction of the small desktop computers that we call 'microcomputers'. For clarity, we need to distinguish these from their antecedents, 'mini-computers' and 'mainframes'. The term 'mainframe' describes the type of large and powerful machine normally used (in education) by higher education institutions for a variety of tasks, some educational, some administrative. Perhaps the most important defining characteristic of such machines is that, even though they might be made available to schools and colleges, they belong to and are run by someone else, and are operated and serviced by specialist technical staff. The means of access to such equipment consists of (for the lucky ones!) a typewriter style keyboard linked into the computer by telephone line, or (for the majority!) 'batch processing' of computer cards completed by students in the classroom and involving a 'turnround time' as the cards are brought in, processed and posted back to the schools. An important feature of most educational computing discussed in this study is its 'interactive' character - that is, the user's ability to get a response from the machine almost immediately after communicating some input to it. This capability is recognised as essential for most kinds of CAL or CML. Indeed, the 'need' for interactive graphics capability, as opposed to that normally available from the alphanumeric (letters and numbers only) teletype, is strongly maintained by some (McKenzie et al,1978). The 'mini-computer' differs from the mainframe (again, for the purposes of this study) in that it resides in the user institution. Around the middle 1970s compact computer systems, complete in themselves and requiring no services other than mains electricity and a small sized room, began to find their way into those schools where staff enthusiasm, expertise and tradition in the technical approach to computer education were strong enough to justify the still considerable purchase price of the hardware and accompanying software (for explanation of the terms 'hardware','software' and 'courseware' see Appendix A). The operation of such equipment was still technically demanding and, as examination of a contemporary description of the 'ideal machine' (Stearman,1974) shows, their usefulness was seen primarily in terms of their support for the development of specialist computer education. Whilst development of 'computer awareness', 'computing across the curriculum' and the administrative use of the computer were recognised as possibilities (Hart,1974; Piddock,1975), such development could only remain secondary and peripheral to the main use as long as costs and availability remained as restrictive as they were.

So, Phase Three in educational computing's history only really began when a new generation of equipment began to arrive. This occurred in the UK with the arrival of the PET microcomputer, a disarmingly insignificant machine in appearance, small enough for the boot of a car or the top of a desk, yet powerful enough to perform real computing operations using the same BASIC (see Appendix A) language as the full-scale machines used by professionals! This machine has now been joined, three years on, by a number similar in concept - the Apple,the Research Machines 380-Z, the Acorn Atom amongst them - and more are introduced every month. The PET has become the most widely used school computer, but, as the rate of computer buying accelerates, it could easily be overtaken by more sophisticated competitors. What made the sudden interest in educational use of computers possible ? The main factor was price. In fact, according to Gleason (1981), it is price that distinguishes the microcompuetr from its predecessors.

> "Various definitions of microcomputer have been offered ...
> Perhaps the best defining characteristic is price."

It is interesting to note that, in fact, almost all we have seen so far is a reduction in the price schools have to pay to BEGIN some educational computing, to make a start. Despite wide publicity that seems to indicate the contrary, provision of equipment sufficient in quantity to cater for large numbers of students is still extremely expensive! A number of costs additional to the purchase of the machine are also involved, though often forgotten at the time of purchase. Costs for the purchase of software and courseware, without which the machines are almost useless, are frequently underestimated and maintenance of equipment usually not costed at all by most first-time purchasers. For all the problems that still exist, there can be little doubt that something new has happened. The microcomputer has brought with it a whole new context within which the development of educational computing is taking place. Far more institutions now have their own machines than could ever have been the case before, and, largely as a result of the increased familiarity teachers have acquired as a result of improved access, there is a growing awareness of the ability of computers to contribute to learning in a wide range of study areas. A new wave of curriculum development, including that being sponsored and coordinated by the DES Microelectronics Education Programme (DES 1981a), has been set in motion. Publishers and suppliers of educational materials are becoming involved in the provision of software and courseware; teacher organisations like MUSE (Mini and Microcomputer Users in Secondary Education) are reporting a significant increase in their membership; a number of academic and semi-academic journals now report the development on the educational computing scene and numerous articles in the more popular computing magazines (Tingey,1981) fuel interest in the educational applications of the 'new technology'; awareness in the BBC of the need for public education in the field of microelectronics and their applications has led to their Continuing Education Project on Computer Literacy (Albury & Allen,1980) and this unique project is soon to be followed by a series entitled 'Micros in Education'. Quite apart from the huge increase in attendance on computing courses per se (Monson,1981), extensive grass roots demand is now evident amongst teachers for in-service training designed to help them understand and take advantage in the classroom of the technical progress that is occurring in the microelectronics field.



At a time when general shortage (no-growth, or even cutback) of educational provision is the norm, educational computing and the curriculum reform required to prepare students for a life with the new technology seem to be areas most likely to attract financial support, teacher enthusiasm and parental approval. Nevertheless, a good deal of money, hard work and goodwill can be wasted if the development is not carried out effectively. A major task for those involved (and, indeed, for this study) is to identify those areas of educational theory that can be of most use in guiding the development, and, through observation and understanding of real life students and teachers and actual classrooms and institutions, plan for the most effective utilisation of the power of the new technology.