

## 3 Some research perspectives

### **The research evidence.**

When I started my reading for this research, the literature on young people and computer use could be loosely categorised as having three perspectives. The first was the impact of computers on motivation, work practices and classroom pedagogy. The second perspective focused on the effects of computer use on cognition. The third perspective was that of the evaluation of predominantly technical issues connected with software, multimedia and the human-computer interface.

Many of these themes are, however, intertwined. The issues are complex because the rate of technological change is such that it is difficult to compare like with like; because young computer users are themselves in the process of developmental change; because they form part of a peer learning community that mediates these effects and because of their expectations that, although nothing will work perfectly, a 'best fit' can be achieved and hardware and software forced to work. The complex information with which I was dealing was reminiscent of aspects of Chaos Theory.

### **Research themes**

The ESRC Information and Technology Programme (1986-90) investigated specific issues involving the use of computers in education: the Information Technology in Education Research Programme (InTER) of 1988-93 established a multi-disciplinary approach to four research themes. The five-year programme investigated:

- collaborative learning;
- the development of basic concepts in mathematics and science;
- tools for exploratory learning and simulations;

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- the identification and evaluation of learning gains achieved through the uses of information technology.

The programme investigated the effectiveness of computers in specific domains. Three questions were posed relating to the information technology resources which they had:

- what do people do?;
- what do they want to do?;
- what can they do?

The four research themes, and the questions posed, are as pertinent today as they were when the programme was initiated. Indeed, the research literature to date has been built on this foundation. The subjects of research that formed the basis for initial studies of the educational use of computers have been extended and developed. The effectiveness of multimedia in education has been examined in depth, as has the use of Computer Assisted Learning in a number of disciplines. (Hodges and Sasnett, 1990; Dwyer, 1994.)

The assumptions that inform these studies developed when computers were not the aspirational consumer good they became in the mid-1990s. Indeed, for most children, access to computers was provided through educational institutions, and teachers administered their use. School was, for the majority of children in North America and Europe, the only place where they could be used.

### **Affective factors**

Other studies have focused on the effect of young people's computer use on interactions within the classroom. Collaborative learning, where computers were a scarce and shared resource, introduced a range of outcomes different from those within a classroom where individual learning was the norm (Somekh, 1986, in Schostak, 1988). The Pupil Autonomy in Learning with Microcomputers Project (PALM) of 1988-90 (Somekh and Davis, 1997) focused on the ways in which computers enhanced pupils' learning, functioning as intellectual tools, to support a range of mental functions.

A significant finding (present throughout this study) was that many teachers regarded the computer as a 'neutral tool' and over-valued the presentational

aspect of computer work. If the computer was a 'neutral tool' then it would simply facilitate the production of work. The improved presentational aspect of the work was therefore to be expected. Teachers would no longer have to battle with poor handwriting; there would be fewer surface errors; students would include tables and charts in their work; in short, students would publish their work.

Other teachers found themselves suffering from 'informational overload' when they were no longer able to control the information flow to which children had access through ICT. When information sources accessible to students were predominantly print-based, the teacher could identify school resources and make a best guess as to the provenance of others. Not only that, but students could be guided to resources. With Internet access and CD-ROM resources at home, teachers find it increasingly difficult to assess unattributed work.

This disjunction between teacher and student perceptions was examined by Monteith (1996), who investigated the ways in which IT was used at home and at school. She identified the possibility of learning being accessed differently at home and at school, with consequent problems for schools, and for those without access to a computer at home.

### **Computers as agents of change**

Literature on the impact of computers on education can either focus on such macro issues as motivation, changing classroom pedagogy and cognitive enhancement, or micro issues such as the effect of computers in specific curricular domains. The advent of the microcomputer has challenged the privileged position of the school as the gatekeeper of knowledge for young people. This opens up macro issues that question the place of education within a social structure. Micro issues examine such factors as the effectiveness of computer-assisted learning programs, or the impact of shared computer access on collaborative classroom settings.

### **Challenges to the structures of education**

Schostak (1988) identified the potential for change that computers offered the education system, in that pupils had, for the first time, the possibility to author

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their own course. He saw control of the process of information handling, in an environment that was tightly controlled, as creating a state of independence for pupils, in that information became a process, the products of which had been constructed. Computers carried a virus that had the potential to create an 'intelligent community' of users, 'augmenting the intellectual power of the individual over that of the political community', but which also heralded the end of secondary education.

Despite these assumptions the culture and organisation of schools persists. What changes have occurred have been in ways that were not forecast. This study, however, sees subtle but profound shifts in attitudes amongst the students themselves, both in the ways in which work is undertaken and the ways in which learning is constructed and situated.

### **Schools as the gatekeepers of knowledge**

Before the increased power and ubiquity of multimedia computing enabled this vision to become reality, however, the introduction of the National Curriculum and changes in teacher education limited the space for such developments. With so much of the curriculum prescribed the time available for experiment and development was curtailed. Nevertheless, a student with a multimedia computer, CD-ROM reference disks, internet access and a range of web sites could be said to have the power to construct their own knowledge and education.

At the same time, evidence was emerging that indicated that computers had a transformational effect on pedagogy and had the possibility for education to fulfil the aims of those who saw it as a way of fostering the autonomy of the individual and enabling each to reach her full potential (Somekh and Davis, 1991).

This view was contrasted with the formal perceptions of many within the structures of the state system, who felt that the tide had finally turned against what were disparagingly termed 'progressive' theories of education. The role of teacher was increasingly seen as that of instructor; and the process as one of filling empty vessels, rather than as facilitating learning and kindling fires of enthusiasm in the construction of knowledge. The contradiction between organisational expectations and student experience became stronger during the course of this study.

The same debate was taking place among those involved with the production of educational computer programs. Watson (1987) examined the tensions

inherent between programmers and teachers, who often had a 'fuzzy' approach to the ways in which they wanted the programs to work. Such teachers felt that the impact of computers in the curriculum, particularly as they were used within Humanities subjects, provided space for a constructivist approach.

### **Changing classroom pedagogy**

The 1990 study of Underwood and Underwood surveyed and summarised current practice involving microcomputers in school. They identified the two perspectives which shaped attitudes: 'formal' and 'progressive'.

### **Computers and the formal approach to education**

The first perspective could be seen as 'formal' or 'traditional', in that learning is seen as the reception of knowledge and the learner is a recipient of information. This approach has much in common with the behaviourist tradition: computers are therefore additional tools through which teachers and the educational process could achieve existing aims and objectives, whilst at the same time providing keyboard familiarity and IT awareness.

Computer programs to support specific curricular aims through exercises and drills provided one set of examples: the Acorn/BBC initiative spawned a generation of teacher-programmers who saw Computer Based Learning as a panacea for otherwise boring routines to reinforce the curriculum. The conventions of spelling and punctuation, routine mathematical operations and other such aspects of the teaching process were entrusted to programs that adopted the format and conventions of computer games. Other programs enabled students to practise compass bearings, giving grid references or producing time lines. The Micro in the Classroom became an addition to the Non Teaching Assistant.

The eventual introduction of Independent Learning Systems (ILS) provided a neatly packaged solution to this approach to learning. Students would sit at computer terminals, log on to their personally tailored program, complete the work and, with appropriate feedback, emerge successful. The students sit in front of their own terminal. In many cases they wear headphones for aural feedback. They work their way through the materials, make changes and receive

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a score at the end. Their teachers can access their learning logs and monitor progress. This Behaviorist stimulus-response approach of many of the Independent Learning Systems is quantifiable and works in that each student is removed from many of the variables of a normal classroom learning environment.

### **Computers and the progressive approach to education**

The second perspective drew on the 'progressive' approach to education, grounded in cognitive and constructivist approaches which saw knowledge as a social and intellectual construct, with the learner as an active participant. The use of computers in schools was therefore a way of changing both the process and the product of the education system. An early advocate of using microcomputers in this way was Papert (1981). His book *Mindstorms* saw the use of computers, and what he terms microworlds, as a way of enhancing and transforming the cognitive capacities of children. Papert's perspectives are firmly grounded in Piagetian Developmental Psychology: LOGO, the programming language which he developed, was seen as a way in which children's cognitive development can be developed through simulations in microworlds.

### **LOGO and cognition**

A number of subsequent studies (Clements and Gullo, 1984; Hughes and Macleod, 1986; Klahr and Carver, 1988) appeared to support these claims. The use of LOGO was seen as a way in which thinking skills could be developed and transferred to other situations.

To date, there is a considerable body of research literature which has evaluated the impact of LOGO use on children's mathematical and problem-solving skills, and a smaller set that examines the impact on affective factors such as motivation and socialisation. Clements and Meredith (1997) cite 85 research papers on the uses of LOGO in schools. Of these, 78 examine the use of LOGO in the teaching and learning of mathematics. Seven studies evaluate the effects of LOGO on attitudes: among them are investigations into social-emotional development (Clements and Nastasi, 1985), self belief and

achievement (Blumenthal, 1986; Emihovitch and Miller, 1988; Horner and Maddux, 1985), and social and cognitive interactions (Clements and Nastasi, 1988). The studies suggest that success in using LOGO as part of the classroom environment promotes self-esteem and enhances development. Collaborative learning and problem-solving are also enhanced (Kapa, 1999).

These studies have not, however, examined the ways in which these skills may be transferred to other aspects of independent computer use. The focus is very much that of a teacher-led educational process (Schostak, 1988). Part of this study examines student perceptions of learning, and the ways in which computer use and skills are transferred.

### **Changing the practitioners**

Preston and Harris (1993) examined the impact of computers in schools on teachers' professional practice, and their need for in-service training. This was at a time when changes in funding for local education authority support services were beginning to affect the provision of such training. At precisely the same time developments in computer technology and software increased the need and demand for such training.

The consequences of this could be seen in the OFSTED review of Secondary Education 1993-97 (1998), which identified pupils' IT capability as poor in 2 in 5 schools, and not as well developed as other key skills. Many students and schools focused only on basic applications such as word-processing. The pedagogy of IT as a subject was described as 'still poorly developed', with too much of a focus on the teaching of mechanical IT skills at the expense of higher-order capabilities. Staff development in Information Technology was most frequently judged by OFSTED to be unsatisfactory.

The document 'Excellence in Schools. White Paper on standards in education' (1997) was, in part, a response to many of these concerns. It proposed, among other things, the creation of the National Grid for Learning and suggested that within ten years ICT would have permeated every aspect of learning. New teachers were to be trained to be fully ICT literate, and existing teachers were to be retrained using National Lottery funding. (The New Opportunities Fund.) All schools, colleges and libraries would be connected to the Internet at the lowest possible call rate, a Virtual Teachers Centre would be established and home learning via the Internet would be developed.

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Whilst the DfEE was simultaneously advocating ICT for its transformative powers and prescribing, testing and inspecting what would be done it was questionable whether school-based initiatives would be enough in themselves to effect change. Cox (1997), however, had identified the motivational aspects of ICT use for students and for teachers (Preston, Cox and Cox, 2000) when both teachers and students were able to use the computers to transform the ways in which they worked. Preston and Cox found that both student and teacher autonomy, together with access to the technology, were key to the successful use of ICT and its impact on learning. This complements research that shows that successful integration of ICT into teaching is also dependant on the fit between the software and the teacher's pedagogical practices (Watson, 1993). These findings were supported in this study by responses from teachers.

### **Moral panics and social perspectives**

A dystopian response to the Utopian vision of the White Paper takes as its perspective the misuses of technology by young people. The activities of hackers led to the Computer Misuse Act (1990), whilst the image of young people out of control on the information highways of the world has led to concerns about the corruption of minors by computer-based pornography (Merchant, 1994), on-line anarchist handbooks and the addictive potential of interactive systems (Griffiths, 1994). The image of socially inept young males becoming addicted to the Internet has also been raised (Turkle, 1995; Griffiths, Miller, Gillespie and Sparrow, 1999). Whilst the ethical issues involved in children's attitudes towards concepts such as copyright and software piracy still remain to be explored, British newspapers have followed the lead of the American press in suggesting that the Web offers a cornucopia for cheating undergraduates. More reflective commentators have worried about the socially divisive effects of the 'information rich' and 'information poor'.

There are many parallels between these perspectives and studies of the uses which children make of television. What is lacking, as with so many studies of children and technology, is the voice of the children themselves, and what they feel they are enabled to do by computers and information systems. A recent study examined the uses made of computer games by children in primary schools in East Anglia, and contrasted this with ways in which computers were used in their schools. (Sanger et al., 1997) They found that many teachers in the study

were ill at ease with the technology; that in many cases the classroom computer was at the periphery of activities, both physically and educationally, and that its main use was as a tool for producing neat copies of work. The ways in which children used computers at home were seen by both teachers and children as fundamentally different from school uses. This is also confirmed in this study.

Turkle (1995) has examined the effects of computer use on individuals in the United States, but her perspective is more that of the psycho-social effects of computer use, rather than on the transformations that young people are empowered to make within their learning. Turkle sees the main impact of computer use, especially with the Internet, as impacting on questions of identity and social placement, offering ‘...new models of Mind and a new medium on which to project our ideas and fantasies. ... We are learning to live in virtual worlds.’ (p 9) She describes computers as ‘objects to think with’. (p 48)

### **Effects of computers as ‘objects to think with’**

Winograd and Flores (1988) on computers, cognition, language and Mind, provide a useful focus for an examination of transactions and processes. Whilst the underlying approach of their work is that of the role of language in constructing knowledge, they characterise the faculty of understanding as pattern recognition, which involves representations and procedures. The work of the neurophysiologist Maturana is central to their thesis of the changes in understanding brought about by the uses of new technology. The concept of plasticity, (Maturana 1970; 1980) and structural coupling within the cognitive system, posits a dynamic interaction between interactions and the structure of the interactive system. As the domain of interactions is modified, so is the structure of the interactive system. In this way the use of computers, and the language representations which their use involves, modifies traditional domains of interactions in the cognitive developmental process associated with children and school. Winograd and Flores’ use of Maturana’s work provides a rationale for the thesis that the use of computers changes children’s thinking processes. Their work complements that of Papert, whose initial work explored the effects of LOGO both as a program and an environment for learning.

Other such programmes of research, most notably based in North America at the Human-Computer Interaction Laboratory at the University of Maryland. (Shneiderman et al., 1989-98) and The Institute for the Learning Sciences at

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Northwestern University (Schank et al., 1990-97), have evaluated the effectiveness of specific computer tools as a way of enhancing the quality and type of learning.

#### **Technology as a metaphor**

Information technology and information processing have been employed by philosophers engaged in the debate between Cartesian dualists and neurophysiologists. A number of writers have examined the way in which the Mind is constructed as a metaphor: objects and processes in our environment are used to construct the metaphors in order that we can understand the Mind. The trend can be seen in cognitive development and symbolic information processing, (McShane, 1991) and on understanding data handling and computer procedures as a way of understanding ourselves. (Leiber, 1991) Parallel with this debate is the reification of computers in the discourse of teachers, students and the Government, in which computers assume an active identity and a super-ordinate role. The National Grid for Learning and the Supergrid for Learning are seen as a way of avoiding

*... a generation of the information poor ... to be productive, Britain needs to become a knowledge driven economy ... (Blair, 1998)*

The view of education as providing the skills infrastructure for a ‘...productive...knowledge driven economy’ is predicated on the assumption that knowledge and information will be readily accessible and shared among society’s members. Information and Communications Technology is seen as neutral, with an autonomous, independent status relative to the structures of society and the actors within it. ICT is also seen as a benign contrast to the old, polluting smokestack industries. The post-industrial world is clean; it heralds the end of commuting; it brings the world of knowledge to the desktop of each individual.

The twin themes that have informed so much of the research on computers, young people and schools – computer as tool; computer as transformer – have here intertwined themselves to produce a thread for the future. The supposition is that the thread will bind us into the web, e-commerce, e-learning and the wired economy. The hope is that unlike Theseus, we will not find ourselves in the dark, at the end of a piece of string with a monster heading towards us.



