

1 The context to the research

Background

As the use of a new technology changes human practices, our ways of speaking about that technology change our language and our understanding. This new way of speaking in turn creates changes in the world we construct.
(Winograd and Flores, 1988, p.6)

From 1984 to 1986 I worked in Damman for the Saudi Arabian Language Institutes, and purchased an IBM-compatible computer for the office. Within a week the Palestinian secretary had compiled a database of all the clients, set up a spreadsheet to track income and expenditure, and was enthusiastically using a word-processor to generate correspondence. He taught himself, with the help of phone calls to friends and the occasional use of the manual. Six months later the routine operations of the office had been transformed, and Ibrahim, the secretary, was able to make suggestions as to the ways in which the administration of the Institute could be changed. The technology had empowered him. When I looked at other companies with which I came in contact I found, to a greater or lesser degree, the same process.

Many of the clerical workers in company offices had been recruited from Jordan, the Philippines, South-East Asia and the Indian sub-continent. They arrived to find a workplace very different from those which they had left. All the offices had installed computers, and the staff were expected to use them. When their contracts had finished many of these bought computers to take home and use in their own businesses. All to whom I spoke believed that these machines would transform their family businesses, and their lives. They saw computers as a means of giving them access to a technological revolution which would plug them into the developed world.

It was not simply that the utilisation of computers for office tasks had increased their efficiency: that tasks could be undertaken more swiftly and easily. The more profound change was that these workers could envisage different ways of doing things. Their style of working could change.

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British schools

In 1987 I returned to work in comprehensive schools in West Yorkshire. The Local Education Authority had chosen to equip all schools with Acorn microcomputers (usually referred to as 'BBC computers', after the promotional television programme.) I found that students and teachers were using Acorn BBC computers for very different tasks to those I had seen in use in the Middle East: here they were used as aids for learning mathematics or science; as a way of presenting final drafts of writing, or, in Business Studies, studying databases. Many enthusiastic teachers were struggling to fit computer use into existing schemes of work, or were teaching students about computers. I found very few examples of teachers - or students - using computers to transform the ways in which they worked, and the outcomes they produced. Computers were predominantly seen as external to the school process of learning and work, and to be used for specific purposes.

I considered that two aspects were central to the ways in which computers should be integrated into the education process. The first was how students could undertake work using a new tool. The second was whether this tool fundamentally changed the artefacts which were produced. These issues were rarely the focus of the way in which teachers used computers with their students.

The articles which I read on educational computing, and the courses run for teachers by the schools' advisory service, were more concerned with the skills which were needed in order to use the computers with students. The dominant approach was for teachers to learn how to use programs to achieve particular outcomes relating to their curriculum, and then to teach the students how to use the programs in order to achieve those outcomes. Students would use computers to learn how to produce grid references in Geography; to calculate the nutritional composition of meals in Food Technology or for word prediction in English using cloze exercises.

Much of the then-current research literature was devoted to the examination of ways in which the use of specific programs could reinforce and extend aspects of the curriculum and the learning process. (The occasional papers published by the Information Technology and Education Programme, (1986-88) and InTER (1988-90) Information Technology in Education Research Programme (ed.

Lewis, R. 1986-90); University of Maryland: Human-Computer Interaction Laboratory; Northwestern University: The Institute for the Learning Sciences.)

Much of the software I encountered in schools had been produced by enthusiastic teachers, whose approach utilised game formats in which students were awarded scores to signify success. The paradigm of Computer Assisted Learning was dominant: short sessions on the computer for specific groups of students to reinforce the normal curriculum.

My professional reservations were that such a policy presented computers and their use as something which had to be taught and applied in specific ways, and that the students' role was no different from that in any other subject. Computers in schools were objects about which students had to be taught. Their use was seen in terms of skills which had to be learned before they could be applied. The power and independence which I had seen in colleagues in the Middle East, when computers were adopted with no formal instruction, suggested that this was not the most educationally beneficial application of the technology. However, it was an efficient way to utilize scarce resources. In such a context it was far easier to use computers to teach students about them, rather than allow students to use them.

Extending the technology

During the next three years the school at which I was working invested significant sums in extending computer provision. A whole-school network was put in place, new software was purchased, and new syllabuses adopted in Business Studies which provided opportunities for independent student work. Staff training sessions were organised to introduce teachers to the new possibilities.

Paradoxically, the increase in investment and the commitment to staff development did not seem to produce a corresponding increase in the use of computers across the curriculum. Where a department adopted computers as part of their work with students, computer work was added as additional units within the syllabus, rather than to transform student work. The Mathematics department scheduled a unit of work involving computers for each student in years seven and eight; the English department added a word processing unit.

There was no increase in the numbers of staff using computers as an integral part of work with the students. Those teachers who had embraced computers

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when they were introduced continued to develop their work. Most, though, saw them as irrelevant to their subject. The weekly timetables and booking sheets for the IT rooms would be used by the handful of staff who attended the IT Support and Development Group meetings. Other colleagues were reluctant to be persuaded to use the facilities. They would cite curriculum pressures that prevented them from taking classes to use the facilities, the unreliability of the machines or the difficulties of managing students in an unfamiliar environment.

Transformations

By 1990, however, the situation changed when a significant minority of students started to have access to computers at home that ran industry-standard software and which had printers. These computers were significantly different from those which students used for games playing or programming. In the majority of cases they were business machines which had been replaced, written off by the accountants and sold to employees for a nominal sum. The coursework these students produced in a range of subjects not only reflected the skills they had acquired at home, but also enabled them to produce documents that many referred to as 'real'. What was interesting was the fact that many students used databases, spreadsheets and graphics to support and illustrate points that they were making in their writing.

One consequence of this was that students were able to analyse data and view a number of graphical representations of it with very little effort. This ability to cycle through different charts and to view the data in different ways meant that students were able to decide which data sets were significant. In turn, this meant that their writing became more analytical: the ability to generate and view a range of data representations meant that causal links could be tracked easily. The length of time which the process would have taken had the students created the graphs manually would have prevented them from contemplating the task.

Another, possibly more significant, consequence was that these students began to plan and organize their work in terms of the technology to which they had access. They would pressure their teachers to use school facilities: students without access to a home computer would add to the demand. Some teachers realised that their lack of expertise could be compensated for by involving IT-literate students as mentors to others within the class.

Investigating the changes

During the next three years a growing number of students with whom I came in contact spoke enthusiastically about the computers they had at home, the ways in which they used them and how these compared with the limitations of the school resources. By 1994 I decided to survey the whole school population to see whether this was indeed the case, or whether I was projecting the enthusiasm of a few students into an unsustainable generality. I also decided to survey students as to why they used computers: I wanted their perceptions.

The investigation of what the students did with computers, and an exploration of their reasons for doing it, required a methodology that would accommodate a range of responses and generate a typology. Previous research I had undertaken in student perceptions of genre in television, and the ways in which they used soap operas such as *Neighbours* and *Coronation Street*, suggested that a Uses and Gratifications typology (McQuail, 1987) might provide an appropriate way in which to approach the data. It was analyzed using a modification of McQuail's Taxonomy of Gratifications.

The first of the whole-school surveys was conducted in February 1995, the second in February 1996, the third in February 1997 and the final survey in February 1999. The data on home ownership of computers confirmed the initial supposition, that a significant number of students had access to these. Whilst many students had access to an IBM-compatible computer running a Windows operating system, in 1995 there was a heterogeneous mix of machines cited by students as computers. Many younger students listed their games machines: others, older systems.

With each survey the impact of the PC on students and their work became more pronounced. The introduction of multimedia machines gave students access to a range of reference material: the last survey showed the impact of the Internet on students' working patterns. At the time of the final survey a computer using a Windows operating system – sometimes referred to as the 'wintel hegemony' - had become synonymous with the term 'computer' for all students.

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The effects

A consequence of this is that students with a machine at home have shifted the site of production for their work from school to home: they feel more in control of their work, they don't have to compete for scarce resources at school, and they can use a newer system which they have configured for themselves.

The rate of change in the computer market and the emergence of computers as consumer goods made it difficult to ground this study in educational research. Much of the background evidence, therefore, was drawn from industry sources, where resources and funding were such that there was an immediacy to the data difficult to achieve in other circumstances. Surveys from manufacturers during this period (ICL, Olivetti, 1997, Microsoft, 1997) and consultancies (McKinsey and Co., 1997) supported the penetration of computers into the domestic market (Longman PC ownership survey, 1997). The McKinsey survey speculated as to ways in which home ownership of computers was likely to change the nature of compulsory education. When Microsoft provided their own Internet service it was described as 'a private education'. For many young people the concepts of computers, Microsoft programs, knowledge and education were becoming inextricably linked. Knowledge and learning were presented as commodities, to be purchased, and replaced when they need updating.

The implications

When computers were introduced in schools in the United Kingdom the computers to which children had access at home were often either machines used for generating programs, or dedicated games machines. Schools used a range of computers, from Acorn/BBC, through Commodore, Dragon and Research Machines, to those assembled by staff and students. A variety of operating systems, software and hardware could be found within those workplaces that had adopted microcomputers.

As 086 IBM PCs with Intel chips and MS-DOS operating systems became standardised in business, so they had an impact on students. With the increasingly rapid changes in technology companies adopted a faster write-down in their accounting policies, and 'obsolete' machines found their way into homes. When Windows became the de facto standard, students who acquired these machines suddenly found themselves with an extremely powerful machine to

learn and use. These computers were increasingly identified by students with the adult world of business, and were therefore regarded as 'real'.

By 1995 PCs were promoted as consumer goods. Programs were distributed on the covers of magazines, and students found that they were able to learn how to use these and combine them with other programs in order to produce work for school. For the first time, a significant percentage of students in this country found that they could learn how to use something that most of the adults in their lives could not. These students worked out for themselves how programs were used: each of them learned slightly differently, and they traded this information at school.

Students are now continually experimenting with new programs, new applications and new technology. They are in a process of continual learning, which they control. They see that much of the computer technology which they have to use at school is older than theirs, with more limited software. More importantly, there is a level of institutional control that is imposed on their use of it that conflicts with their understanding of how the technology could be used.

The quotation with which this thesis opens suggests a social-constructivist approach to knowledge and learning.

As the use of a new technology changes human practices, our ways of speaking about that technology change our language and our understanding. This new way of speaking in turn creates changes in the world we construct.

Winograd and Flores (1988) suggest that the changes which a new technology produces in our practice, the ways in which we work, should also effect a change in the ways in which we speak about our ways of working. If the ways in which we speak about something change, then the ways in which we understand things will also undergo a change, which should, in turn, change the ways in which we perceive the world and construct meanings from it.

If Winograd and Flores are correct, then these changes in student practices should effect changes in the language and understanding of students. These should then produce changes in the world they construct.

The research perspective

The research on which this thesis is predicated was conducted over a period of six academic years. It involved all the students in the school. The longitudinal

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surveys were undertaken in tutor time, and the sample size for each survey varied according to a number of factors: reliability of the school buses, small-group activities during tutor time and student absence. Nevertheless, between 1200 and 1300 students were surveyed during each phase of the research – up to 70% of the school population of 1800. A comparative survey compared these students and those from another comprehensive school in the city. The only comparable large-scale survey with which comparison could be made during this period was the Ultralab survey of emergent capabilities, which was single-phase.

Other surveys involved selected year groups: Years 7-10 and 12. These investigated student attitudes towards using computers for work and the perceived benefits; the ways in which they perceived the Mind and how it worked; the ways in which they thought they learned. Teacher surveys were also undertaken during the research: those from the school were surveyed during the student surveys; those from other schools in the local authority at other times.

The perspective was essentially ethnographic, in that it examined the ways in which young people and their teachers used and made sense of constantly changing technology. This work is therefore about changing perceptions, expectations and conceptions, where knowledge and understanding are constructed with each new action and utterance, and where learning is just-in-time.

Much of the empirical evidence collected during this period is located in the appendices. Some are summaries for this research and for colleagues: others were conference papers or articles for journals. All present snapshots of a process.

I was constantly surprised at the changes and developments the research revealed: my expectations were often subverted.

