# 13 Conclusion

The hypothesis that framed my study was that of Winograd and Flores (1988).

> "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."

My initial assumption was that the changes that I would identify in the ways in which young people used the technology, and the changes it produced in their understanding, would relate to their ability to handle, present and process data.

The surveys I conducted for the first three years of this research investigated the material conditions of computer ownership, the understanding of computers which the young people possessed, and the uses to which they were put. During the first survey the definition of 'computer' was broad enough to include a number of machines that were used for games, although the owners were under no illusions as to their use. It was the technology to which the label 'computer' was applied, rather than the application. Other students identified older machines as suitable for practice in programming. The consensus among students at the school, however, was that a 'real' computer was one which contained an Intel processor and used a version of the Windows operating system. This perception was one that had been formed outside school, the dominant influence of which was the environment of work and employment.

What also emerged during the early surveys was the clear distinction made by students as to the way in which computers were used at school and the ways in which they were used at home, even though the work was being produced for school. It was clear that students regarded their systems as an

extension of themselves and their personality: the ways in which they used the machines constituted an act of creation.

Very few of these students had received specific teaching in ICT at school: what teacher input there had been had been related to how to use programs on the school network and how to apply these to specific curriculum tasks. In other words, these students had learned how to use the systems themselves. As the proportion of students with access to a computer at home increased so did the number and types of programs they used. CD-ROMS and disks containing applications were regarded as common property: students would install a program, try it out and if useful keep it; if not, delete it. Their relationship with their computers is dynamic. They are in a process of continual learning which they control. By contrast, their relationship with school systems is restricted and static.

The changes in the world these students constructed have been ones of cognition and learning. Computers act as a vehicle for the combination of motor skills, manipulation, language and symbolic manipulation, through practical activities. These activities can range from the installation of programs, through playing games in virtual environments to undertaking a multiplicity of tasks for coursework. The software they use predicates a greater range of possibilities, as the activities for which it is used become more complex.

My initial supposition was that the rule-governed nature of software would produce a systematic approach to tasks that involved data handling and its presentation. That does not appear to have been the case. It is, rather, the plasticity of software and the GUI environment that has presented students with the ability to innovate. It is the ease of experimentation that this offers that liberates the bricoleur within individuals.

The point-and-click environment which students utilise reinforces the power of ostensiveness, the operation of pointing, which reinforces learning through representation by imagery and perceptual organisation. The images are the translation into visual form of prior linguistic and mathematical rendering: students perceive and use the icon as an entity in its own right. This is the 'virtual reality' - not the theoretical underpinning of which it is the iconic representation. The spatio-qualitative qualities and properties of the events which the icons on the screen invoke are subsumed by the act of creation and the object that is created.

The concepts of Mind which the students form are those associated with creativity and originality. These construct the individual's sense of identity. It

is a learned construct. For the first time learners have a machine for learning that is powerful, interactive, flexible and personalised. The changes suggested by Winograd and Flores are a product of this, but they are continual changes, a dynamic, the outline of which is only starting to emerge. They have produced an independence in the learners who use computers which is increasingly at variance with institutional expectations of learning, and the relationship between school students and the institution.

For these students, knowledge is in the constructive process: it is concerned with the making of ideas, rather than in finding them to solve a pre-determined problem. In cognitive terms it produces second order cognitive knowledge, which enables students to work things out for themselves and to interpret new structures, rather than first-order tasks, which tend to be teacher-directed (Stevenson, 1998).

Indeed, much research literature is still focused on the institutional perspective. Concern is raised over the effects of multimedia when used in an instructional context: the assumption is that there is an inherent contradiction between the learning styles associated with multimedia and the Internet and the educational process (Salomon, G. 1998). The critique is extended to ICT in American education, and the conclusion reached is that it has produced negative effects (Oppenheimer, 1997). Seymour Papert (1996), on the other hand, approached the subject from the opposite perspective: bottom-up, rather than top-down. His chosen analogy is horticultural: "Give everybody a computer, and then here and there more and more people will find interesting things to do with those computers and new ideas will spontaneously grow."

The model of the education system, based on hierarchical, industrial, modernist assumptions, is one that at present sits uneasily with its subjects. They control their technology: the productive capital. They create their cultural capital. They share a symbolic capital common to those who live in the post-industrial, post-modern digital virtual world.

The challenge for teachers in the classroom is that of presenting the curriculum and the learning process in ways which will enable all to succeed. Those whose intellect and learning style is shaped by their ICT environment must be taught the disciplines of information handling and attribution. Those who are dependent on school-based resources must be provided with an environment in which intellect can be enriched.

The challenge for society and institutions is to incorporate this new reality into their pedagogy and epistemology and ensure that all can benefit from it.

If the challenge is not met the structural and cognitive inequalities that will result will impoverish us all.

## Reflections

A significant number of students expect to do most of their work at home, rather than at school.

Many students regard the knowledge of how to do things as more important than subject knowledge.

Their computers are vehicles for learning: the routes they use to learn are not those found in most classrooms.

The computer has become the integrating focus for the verbal-linguistic; logical-mathematical; visual-spatial and bodily-kinesthetic intelligences described by Gardner. All these combine in the process of learning for young people.

When knowledge is constructed by the students the teacher finds it very difficult to be a gatekeeper.

## New routes, new roles

The research has explored a number of problematic areas in the use of computers by young people. There is no easy solution to their resolution: indeed, we may be trying to solve tomorrow's problems with yesterday's concepts. What follows is an outline of areas for further investigation and work.

## Work at home

Many students have moved the site of production from school to home, because that is where their computers are. Their perception is that such work is more highly rewarded by their teachers. They also find it more 'fun'. This generates two additional problems: students without a PC at home may well be disadvantaged further and the nature of work and behaviour in the classroom changes. Teachers find themselves managing groups of young people who do not expect to produce work in the classroom. Where much of the time in secondary school classrooms is devoted to tasks which reinforce

learning the perception of both students and teachers must change. The construction of 'work', and its relation to learning, marking and assessment will require some adjustment.

**Tools at home**

The tools available to many young people: multimedia encyclopedias and reference works on CD-ROM, scanners and cameras for manipulating images and Internet access, call into question the nature of knowledge and how we assess it. Where there is a growing perception that knowledge is inscribed within the artefact students must be taught the skills of information handling and the associated ethics, particularly those related to plagiarism.

**School a PC free zone?**

School budgeting problems, resourcing issues, concerns over equality and a shortage of suitably skilled and motivated staff could lead some to imagine that the solution is to return to the classrooms of yesterday. If students are accessing information and learning autonomously at home, forming their own intelligence communities, then one role for schools may be to focus on issues other than those involved with ICT. Given the status of ICT within the National Curriculum, the National Grid for Learning, the Virtual Teachers' Centre, and government initiatives to empower young people through 'computer literacy' this is not likely to be an option.

**Integrate ICT possibilities into curriculum**

The alternative is to integrate ICT within the curriculum. Display technologies, such as those of interactive whiteboards, the use of intranets and the Internet, the falling price of palmtop computers and the development of the National Grid for Learning all suggest that the technology is available if the will to use and integrate it is there.

**PC to follow TV?**

During the course of this study the PC has become ubiquitous among students at the school. The convergence of computers, Internet, multimedia, television and telecoms may well mean that our current concerns are a passing phase. In the same way in which television and video is used for teaching without having to be taught, we may find that ICT and computers become so embedded within our praxis that they are no longer an issue.

The emergence of WAP mobile telephony, the use of hand-held computers and Internet access through digital television are all indicators of the pervasive nature of ICT. Digital television web access, with bundled office utilities, may make online learning a reality for much of the population. The membership of online learning communities with global links, such as Oracle's Think.com, may help to reduce the digital divide.

Whilst this may be true for developed economies, the Less Developed Economies that contain most of the world's children have little chance of providing their young people with these opportunities. An understanding of this should form part of the ethical responsibilities which our students must assume. As they take a more active role in society it is to be hoped that they are able to contribute to the global economy for the benefit of all its citizens, rather than simply as beneficiaries of low consumer prices for the computer equipment they use.