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ABSTRACT

This paper describes the ways in which the learning context with technology is "co-constructed" by teachers and learners, and investigates students' response to technology and how the beliefs and actions of students influence the use of technology in their classrooms. The research is a longitudinal case study of a school and its implementation of extensive technology projects over the last seven years. Perspectives from four cohorts of students were tapped in several ways. In terms of student responses to technology, their perception of circumstances which contribute to their learning, and how the beliefs and actions of students influence the use of technology in their classrooms, the major patterns emerging from the data are considered in terms of three themes: context and process for learning; changing expectations for learning; and differential responses to learning with technology. This study concludes that there is evidence that student response to technology influenced teacher practices, both management and pedagogical, and that there was evidence of instances where student beliefs and moves within the classroom influenced the shape of technology use. (AEF)

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## Going to school the technological way

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## Introduction

Technology offers new instructional options for students and a means for achieving the transformations which educational reformers advocate (Means, 1994). Research literature on the implementation of technology in educational settings faces many problems in attempting to investigate the impact. One problem is that most school technology projects present a relatively weak treatment in terms of amount of time students spend on computers and the duration of the project (Herman, 1994). The major issue, however, is the complexity of the interaction between technology and the participants. Like the school reform literature in general, only recently has research concerned with technology implementation considered the dynamic and interactive nature of the events happening in classrooms where computers are part of the teaching and learning process. Hammond (1994), considering the evidence concerning the impact of information technology on children's learning in schools which emerges from two recent United Kingdom reports (ImpacT and Plait), notes that account has to be taken of "what actually goes on in the classroom" (p.259).

Research has begun to point to a complex interaction among computers, the social system of the classroom and the instructional activities and pedagogical goals promoted by teachers (Greenleaf, 1992). Computers influence what happens in classrooms but, in turn, their use is mediated by existing classroom culture (Cochran-Smith, Paris & Kahn, 1991). Teacher beliefs and values and their relationship to technology use have been investigated (Dwyer, Ringstaff & Sandholtz, 1990; Woodrow, Mayer-Smith & Pedretti, 1996). However, the perspectives of students have largely been neglected. There has been research on student attitudes to computers (e.g. Hattie & Fitzgerald, 1987; Kinnear, 1995). Some (e.g. Boyd, 1997) have interpreted student perspectives as involving a description of their knowledge and use of computers; the influence of their home experience; their attitudes to subject areas when computers are used, and their views of the advantages and disadvantages of learning with computers. Student perceptions of the context and process of learning with computers would seem to be central. In order to understand the nature of high school environments which support positive learning experiences for students, students' perception of circumstances which contribute to this learning is needed to gain a more holistic understanding (Phelan, Davidson & Cao, ND).

Informing this research is recent theorising in the psychology of learning and development which places emphasis on the contexts for development and the notion of a socially constructed environment for learning. According to this view, the construction of activities and of expertise in a school classroom is a joint undertaking by the participants. The students' developing knowledge and expertise is built on a framework of activities and settings (including the use of technology), within which they interact with others who guide and channel their development. Although co- constructionist theory views learning principally as arising from activity in socially organised settings like the joint interactions between teacher

and student, it may also be influenced by more indirect means, for example, the availability, provision and organisation of resources and appropriate activities (Rogoff, 1990). Teachers select and arrange activities to meet their pedagogical goals. Beliefs about the learner and task at hand, expectations about progress and outcomes, knowledge about appropriate forms of expertise and ideas about roles and participation will influence the form, function and structure of activities teachers instigate. However, within these activities and settings students actively take and create opportunities for their own learning. They have goals, beliefs and experiences to draw on too. The ideas and actions of both teacher and student influence each other in complex ways (McNaughton, 1995; Valsiner, 1988). The aim of the research is to begin to describe the ways in which the learning context with technology is co-constructed by teachers and learners. The work aims to present the views of students and investigate (a) their response to technology, including their perception of circumstances which contribute to learning, and (b) how the beliefs and actions of students influence the use of technology in their classrooms.

### **Method**

This research is a longitudinal case study of a school (a large fee paying secondary school for 13-18 year old males and 16-18 year old females) and its implementation of extensive technology projects over the last seven years. In the course of monitoring and evaluating this technology implementation, a large corpus of data was collected to document multiple perspectives, using a range of data collection methods. Interviews were conducted with management, teachers, support staff and students. Self report questionnaires were completed by staff, students and parents at various points. Observations were made in classrooms, meetings attended as participant observer and documents related to the implementation of computers were examined (e.g. student work and school policy documents).

Over seven years, a number of issues apparently mediating the success of integration of technology have been examined. The focus of investigation has shifted as the school concerned worked through issues connected with widespread implementation of personal computers. Early focus on increasing access to and use of computers and providing infrastructure support for technology (Parr & Bairstow, 1992) transferred to an emphasis on professional development, at first for technical proficiency (Parr, 1994) then to collegial assistance to ensure more widespread classroom implementation. Then the focus was organisational restructuring for more teacher involvement in the planning and decision making processes with respect to technology (see Parr, forthcoming). This paper extends the consideration of the process of integration to the perceptions of students regarding technology and their learning and to the concept of a co-constructed classroom.

#### Data sources

Perspectives from four cohorts of students have been tapped in several ways. The first cohort of two classes (47) was part of a personal laptop and desktop project which

continued the following year with lower ability students (17), making two cohorts of students aged 13-14 years. These students were interviewed twice each and observed on several occasions in each of their subject classes. Their assignment and test results were examined.

A personal laptop program for older students (16-18 years) in their final two years of schooling was subsequently instituted. These students, who provided most of the data, had, therefore, experienced various manifestations of technology in their school for four or five years. Prior to personal laptops they had used computers in two well equipped laboratories, in the dormitories or in the Information Center attached to the on-line library. Two cohorts of students (400) completed a questionnaire consisting of open ended questions at the end of a year of use. They were asked about adaption; about extent and type of use in their various curriculum subjects, including how classes are conducted with computers and the role of the teacher; about the best and worst aspects of using computers, and about the process of learning in terms of organising and producing work, accessing information and their role as a learner. A sample of students was also interviewed using a semi structured format where the same basic open ended questions were asked of all interviewees. The questions were similar to those of the questionnaire but students were probed to talk in more depth about the ways their teachers had used technology and what had worked well for them in the way the teacher set up learning with the computer and what, conversely, had not worked so well. They were encouraged to reflect on the process of adaption for both staff and students and on the process of negotiation of what was possible and what did not seem to be in terms of teacher's requirements when learning with technology. The oldest cohort (200) responded to a brief questionnaire as they completed their schooling asking them to reflect on the availability and use of technology at the school; on the process of adaption by them and by staff; on any change in the extent, level and type of use over their time at school, and to summarise the type of things that they found the computer particularly useful for. Teacher (60) comment from questionnaires and interviews, with respect to student response to and use of technology, was a secondary source of information to cross check with student data.

All responses to a particular question were aggregated and a largely qualitative analysis of the responses to questionnaires and interview questions was undertaken to look for general patterns and themes. When the major themes were identified, the data were re-examined to test the usefulness of the framework derived.

### **Results and discussion**

In terms of student response to technology; their perception of circumstances which contribute to their learning, and how the beliefs and actions of students influence the use of technology in their classrooms, the major patterns emerging from the data are considered in terms of three themes, namely, context and process for learning; changing expectations for learning, and differential responses to learning with technology.

### Context and process for learning:

A useful way to view the context and process for learning is in terms of personal systems and of joint systems for development (after McNaughton, 1995). In terms of the development of personal systems for learning, students commented on features which related largely to their organisation for learning. Even after extended use (an average of three hours per day over a year) students continued to like using computers, a liking based on an appreciation that the technology offered numerous advantages. "Work is easy to find; easier to keep so don't lose it". "It is good for storing and saving information". "All my notes are much better organised". There was a general consensus that organisation was facilitated. One student linked this logical filing of information to "a measurably increased ability to scan and revise specific areas of study". Information so organised was subsequently "easier to read and learn from". In fact, the majority of students commented on the advantages for presenting work particularly for assessment. Some utilised features of the software like "stickies" to remind them, for example, when assignments were due. A handful (less 5%) commented it was more difficult to operate where there was a "half paper, half computer filing system" and felt that "it made things more complicated".

Students also recognised efficiency advantages, like allowing them to access content material readily so that more time could be devoted to answering questions or to the discussion of ideas and concepts or allowing them to return easily to a half completed essay or to submit work for assessment just by sending it electronically to the "drop box". Many thought their productivity enhanced not least of all because they could take notes quicker. They noted increased access to resources ("so much information"), particularly current material like Reserve Bank information from the Internet and local facilities like Kiwinet. Furthermore, they were able to work at different times and places. "The laptop is portable so I can work anywhere".

Despite such observations, when students were asked directly whether they thought that they learned any differently with access to personal computers, about a third said "no". However, comments indicate that there were changes in the way some went about learning. For example, the different modalities available through the computer helped learning. Visual images (programs for bio-mechanics and the respiratory system were mentioned) were useful because "I remember visual things". Another visual learner commented how s/he could "see" the different coloured subheadings in the notes made. Graphs made while conducting chemistry experiments like titration enabled students to appreciate the nature of the reaction or graphs in algebra, the nature of the relationship. One student said s/he grasped better the concept of a key in biology through learning to produce a hypercard stack. Some students used the sound facilities to read back their notes to provide another modality to help learning. One even confessed that, too shy to give a presentation, s/he simply got the computer to read it!

A number of students commented on the need to process in some way the information available, for example, from the school server. They did this by acting on or manipulating the material - making summaries, comments etc. "It is like having a big text you can write in". Interestingly, someone reflected at interview that if a teacher dictated notes and they handwrote them, they would not necessarily engage in this further processing. One student at least was convinced that s/he needed to hand write material in order to learn it- "I still think on paper; the actual act of writing is important for my learning".

Comments from a few students were concerned with the passivity of the form of learning they were experiencing. Having access to notes readily on the server, noted one, "doesn't make you work as you can always have it". Another observed, "Because I am not taking notes down, I am not learning what I understand but rely on the teacher's understanding, which may not be the same". Yet a further student reported that s/he did not read as widely so "was more likely to see only what the teachers see".

There is evidence that extended use of word processing enabled students to compose in a different way and to reflect more readily on the process (Parr, 1995). The speed with which they could record thoughts meant essays "flowed better". Speed of transcription had down sides for some who noted that with handwriting one only takes down the main points whereas a fast typist can take everything down and can be left wondering what is the more important material.

Joint systems recognise the development of expertise within a social situation. In this instance there were comments that indicated recognition of a change in traditional classroom roles and arrangements. Previous experience of schooling and expectation of the role of the teacher as the imparter of knowledge were clearly reflected in comments of the ilk "<the teacher> does not teach as well; the computer does the teaching". In fact Cuban (1993) makes the observation that the lack of technological progress in schools is partly because, as he puts it, schools are less vulnerable to technology because of certain cultural beliefs about what teaching is and how learning occurs, what knowledge is proper and what the teacher-student relationship is. He points out that secondary schools are bound by a certain social organisation of instruction which creates a durable, practical pedagogy.

There were other indications of student expectation of teacher role. Research has suggested that computers in the classroom increase the level of activity and, initially at least, for teachers there are management issues and issues of control (Sandholtz, Ringstaff & Dwyer, 1997). Clearly this may have been the case in one or more classrooms as a dozen students in response to a question about the role of the teacher said "a dictator". In other classrooms the students described the teacher as "not in control". This may have reflected students' previous experience of largely silent, classrooms, with students working individually towards the same goal; it may have been a comment on the teacher's lack of knowledge of computer operations ("they are supposed to know more than us"), or it may have reflected an



expectation that the teacher be actively directing classroom moves rather than allowing students to work more independently. There is support for all three explanations in the data.

A Vygotskian view of learning and the development of expertise is premised on the gradual transfer of control of the task from the expert to the novice. Students described working more independently. Software such as "Interactive Physics" enabled what one student described as "self experimentation", where students could set up and conduct experiments themselves. Some saw the use of the laptop with the concomitant access to information as freeing the teacher for "more discussion of ideas and concepts"; "there was more explaining and less writing". However, one student observed that there was less teacher time available; another commented that there was "less communication between teachers and students" and yet another observed that there should be "a mix- a bit more of the teacher".

In responding to questions about their role as learner, a number of students noted that the use of the laptop meant that they had taken increased responsibility for their own learning "for setting <their> own goals and pace"; "Learning is more up to you- you have to have self motivation" noted one while another claimed that in "learning for yourself, you don't forget". They responded differentially to this challenge.

#### Changing expectations for learning

Aside from the changing expectations with respect to the degree of independence with which students would pursue tasks, expectation of level of computer literacy also changed as students advanced in the school. "Class teachers make you use <the computer> more as you progress up the school". A few students felt that staff had both an unrealistic expectation of their level of computer skills and of their ability to produce work more quickly. They reported that often teachers expected to be able to talk at a normal pace and that you could take sufficient notes, rather than talking at a normal hand writing pace, where they repeated things and paused to allow you to catch up. The speed with which some could produce work led some teachers to "give more notes".

Almost all students commented in some form or another about the changed standard of presentation of their work as a result of both typing it and of the editorial features of word processing. Many noted that teachers came to expect this high standard of presentation. Still others commented on the changed expectations in terms of the depth of research or the detailed nature or recency of the material required for assignments. "<Teachers> expect up to date information from the internet".

#### Differential responses to learning with technology

Not every student chose to utilise the technology available. Although they possessed their own laptops and although teachers presented opportunities for it to be used, there were some students (about 10%) who said they seldom used the computer. "I have this heavy piece of junk to lug around school and hardly ever use", wrote one. Another claimed never to have used his laptop and a further three reported using it "as little as possible". Another,



responding to the question to describe computer use on a typical day wrote "I take it to school, carry it around, take it home again and play games".

For a small number of students, attempts to utilise technology widened the gap between them and their more able peers, a phenomena akin to the Matthew effect (Stanovich, 1986). One explanation of the Matthew effect within reading and writing research has been that high and low progress writers and readers are exposed to qualitatively different experiences which serve to reinforce and even increase inequalities in knowledge and skills. Research has yet to detail the mechanisms which construct this difference.

The differential treatment theory (Cazden, 1988) emphasises the actions of teachers and the influences on teaching as unintentionally increasing differences in levels of knowledge and skills. It appears that teachers respond differentially to more and less expert students but that, within this interaction, moves are influenced by student contribution (Glasswell, McNaughton & Parr, 1994). Organisational strategies designed, for example, to support immersion or independent learning, favour those students already primed to take advantage of such opportunities. But the range of choices for the teacher may be constrained by the actions of the student. There is literature (e.g. Hannafin & Savenye, 1993) which discusses the teacher's resistance to a new role (coach, guide, initiator, organiser, diagnostician) but there is evidence of a similar phenomena for students. There was some evidence (triangulated from teacher interview, observation and student comment) that, particularly in lower ability classes, students resisted the independent work required of them. They preferred more structured, directed activities which involved using the computer like an electronic textbook. Woodrow, Mayer-Smith and Pedretti (1996) noted that students often had difficulties with being given more ownership and control over the pace of learning and preferred to be told the pace to work at. In the present study, difficulty using the computer added to student discontent and their tardiness in completing required work led the teacher to alter the demands, in the process changing the way he had been operating pedagogically to a "more structured, didactic approach".

Also, for some, their previous experience of schooling and their perceptions of the role of the teacher as the knowledge giver made them question whether teachers were doing their job when students were finding their own materials, making their own notes etc. For such students there may have been a mismatch between the way of doing established in previous schooling and the current situation, another possible explanation for the Matthew effect.

Difficulty using the computer is another explanation for a widening gap. For some, the cognitive effort involved in learning to operate software (about 3% of students continued to find it difficult to load and operate after a year), or to acquire keyboard skills remained an issue over an unacceptably long period and continued to take up processing capacity. "I have to concentrate on finding the keys rather than taking notes and learning" wrote one student while another lamented that his typing was still "slower than writing".

Laptop use also seemed to compound the problem of those experiencing organisational difficulties. Some students confessed that they could never "remember where files were or what they had been called " and others "spent more time setting up than actually doing the assignment". Some, like the students in Sandholtz, Ringstaff and Dwyer's (1997) work, found it difficult to manage their time, for example spending inappropriate amounts of time on font size, layout, changing the screen saver, the colour combinations etc., decisions which are the hi-tech equivalent of borders, decoration and colouring in. Although breakdowns and other technical glitches were a source of frustration for all students, they were accentuated for some students who reported more difficulty reverting to paper and pen, then back to laptop. Technical difficulties also provided students with ready excuses for failure to produce required work.

The computer classroom seemed to provide additional distractions for some. "Classes are noisier due to typing ", reported one student. There were distractions stemming from public nature of other's screens. More often commented on, though, were distractions from material students loaded on to their hard drives. Most students reported playing games. "I had about 250 megabytes (?) of games loaded on at one stage. I was addicted so I had to take them off. I suffered withdrawal symptoms". Although the school had a very strict policy on game playing, it was difficult to police. As one student explained "It is difficult to monitor as in only two keystrokes you are out of the game and back to work". One teacher was reported to have erected a mirror, like those in stores which help monitor customer moves, to watch for game playing. However, his previous training and experience may have contributed to the fact that he seldom remembered to scan the mirror so game playing went unchecked. Displacement activity also occurred out of class in the form not only of games but of the loading and viewing of "jiffs" of interest to adolescent males. The sending of messages by electronic mail also consumed inordinate amounts of time and energy for some.

### **Conclusion**

This study has begun to redress the balance in the technology research literature which has tended to view students, or at least their learning or self concept as a dependent variable (Means, 1994), rather than considering them as active contributors to the complex classroom community where technology is present. The study has considered technology and learning from the learner's viewpoint. The use of personal computers has influenced the development of personal systems for learning, notably organisation for learning but also computers have provided other modalities for learning. Adding technology to mix in the classroom has impacted on the nature of joint systems, particularly in respect of the transfer of responsibility for learning. There is evidence that student response to technology, for example, the extent of their willingness to acquire or use the necessary expertise, or their willingness accept more responsibility for their own learning, influenced teacher practices, both management and

pedagogical. There was evidence of instances where student beliefs and moves within the classroom culture influenced the shape of technology use.

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