INVESTIGATING TECHNOLOGY-MEDIATED, PROJECT-BASED LEARNING: CASE STUDIES OF FOUR SCHOOLS

FINAL SUMMARY

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1 Introduction

The study uses case-studies of schools identified as using technology-mediated collaborative projects (as part of their ASISTM grant endeavours). The study stems from the *Schools Innovative Learning Cooperative* (SILC), a unique group comprising e-learning leaders from private, state, primary, secondary and tertiary educational sectors. It seeks to investigate the value and use of collaborative, technology-based student projects in K-12 schools. In particular, it aims to identify, examine and analyse pedagogical practices in relation to these projects in four case schools. A further aim is to investigate teachers' professional learning in these contexts, and to identify student learning outcomes. Research questions include:

- How do teachers' beliefs about learning influence their use of collaborative student projects?
- What pedagogical approaches are used with these projects?
- What is the role of ICT in supporting these projects? What other contextual factors constrain or enhance the effective use of collaborative projects in teaching and learning?
- What do students learn by engaging in these types of projects? What student learning outcomes are supported by these collaborative projects in the Maths, Science and Technology curricula?
- What is the nature of the teacher roles, the peer learning structures and the learning tasks associated with these outcomes?
- What do teachers learn by engaging in these types of projects?

2 Background

Mason (2002) suggests that although many articles, case studies and conferences have discussed the value of new technologies for best practice, very little evidence has emerged from these studies. Problems have been the ongoing changes in technologies and development of new ones that make it difficult to study any technology in a substantive way. Mason suggests that we have a need for studies that provide understanding on how to engage students affectively and how to create exciting electronic-based learning in a variety of curriculum areas. This study develops understanding in both of these areas.

Selwyn (1997) suggests that case studies that analyse what is happening in a technology-using classroom and that investigate the relationships the users develop towards the technology are of more value than studies that predict outcomes of technology use. His suggestion is that research should concentrate on the socio-cultural aspects of computer-based learning, a view held by the researchers in this study.

In general, the literature on computer-based learning makes many claims about good practice resulting from computer technology use, but most of these claims are untested (Schuck, 2002a). Indeed, in studies of exemplary practice in schools, the selection of case schools is often based on problematic assumptions about exemplary practice, for example, that results of Basic Skills Tests will identify exemplary practice. In two examples of such studies (Hayes, Schuck, Segal, Dwyer & McEwen, 2001; Schuck, Foley, Johnston & Barnsley, 2002), the researchers felt that being directed to investigate practice in schools which had been identified as exemplary by others, detracted from the understanding of what was happening in the classroom by limiting observations. Therefore, in this study researchers did not look at practice

identified as exemplary by some external criterion, but considered examples of pedagogy using collaborative student projects which have not been labelled in any particular way.

The researchers bring to this study their understandings of good practice (see for example, Schuck, 2002b) which emphasise inclusivity, engagement, encouragement of student autonomy, collaborative learning and access to subject content. These understandings were supplemented by knowledge of other frameworks of good practice (for example, Newmann, 1996). The researchers considered the pedagogies used in the cases in the light of these understandings and also with a view to broadening their understandings in the context of new and innovative technologies.

In summary, the broad aim of this research was to conduct an in-depth study to provide understanding of what is happening in a set of classes using ICT-mediated collaborative student projects, and to focus on the pedagogical practices rather than the technological ones.

3 Research plan

Data on the practices of the teachers and students were collected and analysed from a socio-cultural perspective, in which the interactions of the group, their past experiences and beliefs, and the impact of being researched, are all seen as part of the research data. Our methodology is supported by educational technology theorists such as Neuman (1989) and Salomon et al. (1991) who have advocated more naturalistic studies that provide appropriate data about relevant social and cognitive processes in order to explore the affordances of innovative technologies. By developing an understanding of ways in which teachers' beliefs, pedagogical approaches, and contextual factors inhibit or encourage good practice (as delineated above) in the use of collaborative projects, the researchers were able to suggest a set of principles that indicate good practice in using technology for pedagogical purposes.

Methods and techniques

Participants and context

Four NSW DET schools participated in the study: a K-6 school in Sydney; a coeducational secondary school outside of Sydney; a coeducation Years 11 and 12 only school in Sydney; and a secondary girls school in Sydney. Further details of each project can be found at http://www.treocom.net/silc/index.html

Data collection

Data was collected in a number of ways.

Observation: Observations of the classes at work on the technology-mediated projects. These observations included the initiation of the projects, implementation and culminating presentations, including the Showcase day at the end of the year.

The researchers acted as observers in the classrooms to develop an understanding of what actually occurred. The roles of the teacher, students, parents and school administration were considered in these observations. A semi-structured observation schedule was used to enable the observers to have some uniformity in their observations of the teaching and learning and at the same time be flexible

enough to allow observation of the unexpected. Of interest were peer learning structures and ways that the students interacted within these structures, who initiated activities and directed them, the nature of learning tasks and the ways in which learning outcomes were achieved, and the ambience of the classroom. For example, researchers observed the interactions in the classroom, noting whether they were teacher-student interactions or student-student interactions. The types of interaction, such as questions posed by teachers or by students and the purpose of the interaction was also noted. The role of technology in supporting these activities and processes was also noted. Hence, researcher field notes included memos made while observing a case as well as notes regarding anecdotal conversations with participants. Some still photographs of the classrooms were used to support the written data in the analysis, interpretation and reporting of the cases.

Interviews: Interviews were conducted with co-ordinating and participating teachers, with teacher associates, and with students, throughout the duration of the projects Teachers were interviewed before, during and after the projects and selected students also were interviewed in focus groups after the project. Groups of 4-6 students were selected for these interviews by means of purposeful sampling (Bogdan & Biklen, 1998) based on researcher observations and teacher recommendations. A semi-structured interview schedule was developed and questions probed teacher rationales for using technology and for clarification of how this technology fits with their beliefs about teaching and learning.

Surveys: Some cases collected data through surveys given to teachers and students at the start and end of the project.

Document Collection: Artefacts included students' and teachers' reflective journals, photographs of the projects, digital narratives, web pages and students' digital artefacts from their projects products (such as Lego/Logo machines).

Analysis

Each case was examined for what it said about practice, pedagogy and beliefs about pedagogy and educational technology. The story of each case was constructed and developed from the multiple sources of data on that case. Researchers developed the case stories from the data, and engaged in critical collaborative reflection (Bullough & Gitlin, 1991). This process enabled the researchers to interpret the stories in the context of the case school, the researched and the researcher and to modify their criteria for good practice to fit the case context.

4 Summary of Research Findings

A summary overview of the findings drawn from the collective case of four schools is presented below.

1. *How do teachers' beliefs about learning influence their use of collaborative student projects?*

The design of each project evolved from the participating teachers' underlying beliefs that:

- technology must be integrated within the curriculum not be an adjunct to it
- the project must be authentic and have real-life application
- student learning will be maximised when they are given opportunities to learn from experience
- project-based activities must be hands-on
- the project must be sufficiently challenging to engage and motivate learners
- activities must be sufficiently open-ended to enable students to drive the project.

2. *What pedagogical approaches are being used with these projects?*

The various projects enabled teachers to engage many effective pedagogical practices to maximise the students' learning experiences. Specifically, the various projects were seen to:

- integrate other relevant sources and resources (eg. guest speaker – inventor)
- collaborate with a variety of staff and other experts
- promote a student-centred learning environment
- encourage student collaboration
- promote a problem-based learning model
- strategically and purposefully give students loosely-defined outcomes to enable sufficient flexibility for students to pursue their own interests
- vary delivery between whole class/grade demonstration and discussion and autonomous small group work
- provide opportunities for students to demonstrate and explain the technology to peers, parents and others.

3. *What is the role of ICT in supporting these projects? What other contextual factors constrain or enhance the effective use of collaborative projects in teaching and learning?*

Contextual factors that were found to enhance the various projects included:

- allocating sufficient time for a 'big project' – enabling it to be a long-term project which the students could continue to work on over an extended period of time
- having a project manager who was an expert with the technology to drive the project OR
- having a project manager not an expert with the technology but with sufficient motivation to drive the project
- support from parents
- support from the school principal
- opportunities for team-teaching and collaboration between staff
- sufficient funding for equipment
- access to additional resources (such as free web-based materials)
- appropriate links being made to other Key Learning Areas and syllabus outcomes

Contextual factors that were found to constrain the various projects included:

- insufficient training for teachers who were not familiar with the technologies being used
- time-commitment required to initially set up the project initially
- time commitment required to actually run the project and report on its outcomes
- a lack of clarity of purpose amongst some participating school staff

4. *What do students learn by engaging in these types of projects? What student learning outcomes are supported by these collaborative projects in the Maths, Science and Technology curricula?*

Student learning evidenced through the various projects was diverse and included intra- and interpersonal development, such as:

- negotiation skills
- value and respect for peers' ideas
- collaborative skills
- communication skills (across classes, grades and schools)
- developing a work-ethic (working toward desired goal)
- perseverance and commitment toward achieving outcome
- problem-solving – independently and collaboratively finding solutions to problems as they arose

Naturally, ICT related learning was evident, particularly:

- high level technical skills (eg. programming robotics)
- self-teaching and peer tutoring skills related to the technology
- adapting, modifying and refining ideas to suit the available technology

5. *What is the nature of the teacher roles, the peer learning structures and the learning tasks associated with these outcomes?*

The roles of the teachers who participated in the projects varied considerably but generally the teachers were observed to:

- take a non-traditional teaching role (eg. not necessarily be the expert)
- engage in formative assessment of students throughout the process
- team-teach to draw upon the expertise and skills of each other
- allow students to be self-directed and take control of the learning experience

Students were grouped in various ways, including friendship groups and teacher-allocated groups. These peer learning structures resulted in the following outcomes:

- students acknowledging each others' strengths and weaknesses
- students resolving communication break-downs between peers
- students negotiating their different perspectives to take account of various viewpoints

6. What do teachers learn by engaging in these types of projects?

The participating teachers articulated their learning from engagement in this project as follows:

- increased understanding of the technologies generally
- first-hand experience on how to actually use the technologies
- awareness of how to effectively integrate curricula
- importance of cross-grade and interdepartmental networking
- knowledge about their own students (in terms of their collaboration, co-operation and negotiation skills; perseverance, etc)
- increased confidence in letting students run with their own ideas
- managing students in different contexts
- managing both small groups of students and students in large numbers
- time management
- appropriateness of team-teaching
- professional development provided by SILC (eg. digital narratives)
- inter-school relationships
- working within a given budget

5 Discussion of Research Findings

The collaborative technology projects required an environment of high mutual support for participants to work at different rates and sites. Although all members of this ASISTM project were known to each other, it took time for the particular needs of each project to be identified and for the strengths, and therefore potential contribution, of individuals in the cooperative venture to be productively exploited. Nevertheless, events and initiatives rapidly came together. The projects demonstrated that the teachers, though busy with normal duties, could drive technology initiatives in their schools with support from university and NSW DET partners. It illustrated that support for initiatives could be derived by the sharing of experiences within a cooperative, which consisted of: classroom teachers, heads of departments, members of school executive, university academics, mangers and consultants from NSW DET Centre for Learning Innovation. It is noteworthy the school based projects have continued beyond the period funded by ASISTM into 2007. This illustrates that the projects initiated by the innovations in each school are being sustained and developed. As always, professional and student learning outcomes were difficult to measure. There was evidence of teachers gaining competence with specific technologies, developing their confidence with facilitating students' teamwork and managing out-of-class learning environments, and developing skills in formative assessment, project management and planning. The view of those closest to the projects, the teachers themselves, was that the majority of students demonstrated good learning outcomes. All teachers observed positive teamwork and problem-solving skill development and increased levels of competence and confidence with the technologies. Students appreciated the opportunity to experience the use of sophisticated technologies and became aware of real-life applications (GPS for bushwalking and sailing, radio for airplane pilot communication etc.) It was anticipated that these outcomes would become more pronounced with new iterations of the projects.

There is general agreement that authentic tasks provide real world relevance and personal meaning to the learner. CTGV (1990) believe authentic tasks involve 'life-like' tasks, which require decision-making, exposure to real-world information

and also allow students to generate their own problems to solve. They also delineate *task, factual and process* levels of authenticity. Task authenticity refers to the extent to which tasks are realistic and offer problems encountered by real world practitioners. Factual authenticity refers to how particular details of a task (such as characters, instruments etc.) are similar to the real world, while a process level of authenticity refers to how learner practices are similar to those practices carried out outside of school. Each project in this study displayed some elements of all three levels of authenticity.

However, tasks in this study generally fitted a 'simulation model' of authenticity (Radinsky, Bouillion, Lento & Gomez, 1998), using the school environment as a 'practice field' (separate from the 'real community') but still providing contexts where learners could practise the kind of activities they might encounter outside of school. Given more time and support, future iterations of these projects (and accompanying research) may further explore a 'participation model' of authenticity (Radinsky et al., 1998), where students participate in the actual work of a professional community, engaging directly in the target community itself. Students adopt real roles in out-of-school communities and tasks are 'ecologically' authentic (Barab, Squire & Dueber, 2000) to the degree to which learners engage in authentic practices of a community (Lave & Wenger, 1991). The role of new technologies in providing a 'bridge' to such participation also needs further investigation.

Teacher participants developed a range of professional learning outcomes. They used new technologies to provide real-world, rich contexts for student learning across the NSW K-12 Mathematics, Science and Technology curricula and employed student-centric approaches to motivate and engage their students in team-oriented, problem-solving tasks. It is anticipated that these positive outcomes will continue through similar, sustained future projects in each case school.

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