INVESTIGATING STUDENT NETBOOK USAGE USING ACTIVITY THEORY

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Abstract

As schools move to 1:1 computing, research is required to inform the design and provision of access and usage by students. Drawing upon Activity Theory as the conceptual framework, and through employing a mixed method methodology, this study seeks to determine whether or not netbooks are an appropriate computing device for Year Seven students. Specifically, it investigated whether or not the ratio or quantum of access to the devices was a significant factor in these effects in the following variations of student access to netbooks:

- *1:1 student to netbook access - five days per week for six weeks;*
- *1:1 student to netbook access - three days per week for ten weeks;*
- *2:1 student to netbook access - five days per week for six weeks; and,*
- *2:1 student to netbook access - three days per week for ten weeks.*

This paper reports early findings of that study designed to investigate four patterns of access and usage in four Year 7 classes in a Non-Government Primary School in Queensland.

Exploring netbooks and 1:1 computing

This paper provides some early findings of a study undertaken to determine the appropriateness of netbooks as a computing device for Year 7 students. A netbook is a very small, light-weight, low-cost, energy-efficient device (Taylor, 2008). The term netbook was coined by Psion in 1999 as a generic term for small, form-factor portable computers with sufficient processing power for Internet and other core computing functions such as word processing (Monticello, 2008). The study investigated the impact of their use on the classroom environment and on student collaboration in four, Year Seven classrooms. This study is significant as schools, which might be interested in exploring netbooks as an option, need guidance not only on the use and effectiveness on 1:1 computing, but also need to determine whether or not netbooks provide an economical, practical solution to the provision of 1:1 computing. Few studies provide this guidance, as Penuel (2006) demonstrated in locating only 30 studies of 1:1 initiatives that used rigorous research procedures. The majority of these studies focused on urban, middle school or high school students in affluent American schools (Russell, Bebell, & Higgins, 2004).

Literature Review – uLearning and 1:1 Computing

The term *ubiquitous computing* was used by Mark Weiser (1991 in Swan, Hooft, Kratcoski & Schenker, 2007, p. 482) who stated that 'The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it'. For the purposes of this paper, the definition of ubiquitous or 1:1 computing is adopted as being, 'every student in a class has a learning device to participate in learning activities. These devices are mobile and equipped with wireless communication capabilities' (Liang et al., 2005, p 181). Ubiquitous computing – or uLearning - allows students individual access to learning activities which suit their learning styles, preference and/or learning needs. This suggests that there no longer needs to be a 'one size fits all' approach to learning and that "multi-modal options and device independent access will be the norm" (Millea, Green & Putland, 2005, p. 13).

To determine the technology device to enable 1:1 computing for this study, considerable investigations were conducted, including reviewing ubiquitous, or 1:1 computing research (e.g. Russell, et al., 2004; Franklin, 2007; Penuel, 2006). The initial intention was to use PDAs as the computing device due to the mobility and functionality which they provided in terms of available mLearning tools. mLearning can be defined as "the intersection of mobile computing and e-learning that includes anytime, anywhere resources; strong search capabilities; rich interaction; powerful support for effective learning; and performance based assessment" (Abernathy, 2001, p. 1). Keegan (2005, p. 3) suggests that PDAs are the most appropriate tool for mLearning in terms of a balance between functionality and mobility. However, there has been continual development in mobile technologies, and consequently, in late 2008, the decision was made to use netbooks, rather than PDAs.

The Acer Aspire One model was chosen as the most appropriate netbook to use in my study. While still providing the positive aspects of PDA use, such as mobility, sense of ownership, 1-1 access (Abernathy, 2001; Roschelle, 2003), netbooks minimise the negative aspects of PDA use; e.g. small screen, input limitations, limited functionality (Oliver & Barrett, 2004; Serif & Ghinea, 2005). netbooks were also considered more appropriate than full size laptops in terms of size, portability, weight and cost. As displayed in Figure 1, Keegan's (2005) diagrammatic representation of eLearning and mLearning has been built upon to incorporate the affordances of netbook computing devices. We suggest that eLearning / mLearning and functionality / mobility perspectives should not be seen as dichotomous but rather as relational. In other words, a desktop computer has limited mobility and high functionality and a mobile phone has high mobility and limited functionality, but both devices have characteristics of both perspectives.

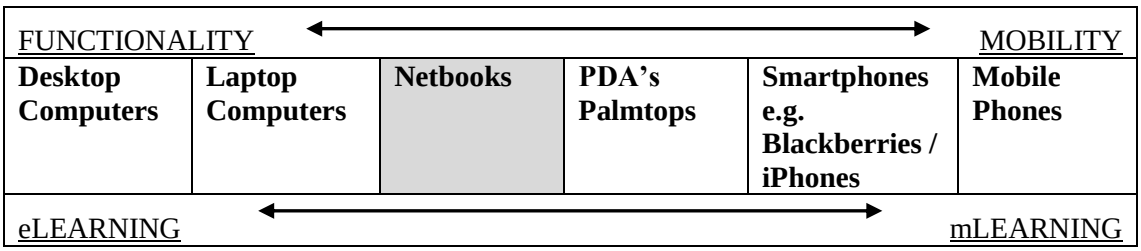

Figure 1. Functionality and mobility reconceptualised in terms of a continuum of learning modalities

The use of computers in education has been comprehensively researched both in the international educational community (e.g. Keegan, 2005; Lim, 2002; Penuel, 2006; Roblyer, 2006) as well as the Australian context (e.g. Jamieson-Proctor & Finger, 2008; Fluck & Robertson, 2006; Lloyd & Cronin, 2002; Romeo & Walker, 2002; Newhouse, 1997; 1998). A review of the relevant literature also revealed that research has explored the effects of computers on student learning and has generally reported positive outcomes for students (Silvernail & Lane, 2004; Warschauer, 2006) although these findings are not universal (Newhouse, 1998; Russell et al., 2004). There are emerging studies which collectively indicate that ubiquitous access to digital technologies, such as laptop computers can have a "profound effect on student achievement" (Livingston, 2009, p. 67). For example, the study of 259 laptop-using students in California (Gulek & Demirtas, 2005) showed that students with 1:1 computing had higher marks than their non-laptop using peers on standardised tests for English, Mathematics and writing.

Although 1:1 computing is being increasingly promoted in Australia through the Australian Government's *Digital Education Revolution* (www.digitaleducationrevolution.gov.au), little is known about whether or not varying the pattern of access impacts upon learning outcomes. In particular, while there have been studies of laptop use, there is little evidence-based research about the effects of wireless enabled netbooks when the access to the devices is varied according to quantity and access patterns. Given the cost advantage for schools of netbooks over most laptops, greater 1:1 access might be able to be provided in schools where funding for technology is limited.

Research Questions and Activity Theory

The research questions which this study explored were:

1. Did varying the ratio of netbook availability – i.e. from 1-1 to 1-2 or varying the pattern of availability - i.e. five days per week for six weeks vs. three days per week for ten weeks effect student usage in terms of quantum (as a ratio of available time) and quality of use?

2. Did the specific "learning mobility and functionality" provided by the netbooks impact on their uptake by Year Seven students and were netbooks an appropriate solution to identified problems with laptops? - e.g. size, weight, battery life, cost (Rockman, 1997; Hill & Reeves, 2002).

3. Did the opportunity for ubiquitous access to the netbooks effect student to student collaboration and types of classroom communication?

4. Did the opportunity for ubiquitous access to the netbooks effect the classroom environment?

Throughout 2009, four Year Seven classrooms had varied levels of access to a set of netbooks for 30 school days. Four patterns of usage were investigated;

- Class A. 1-1 student to netbook access - five days per week for six weeks;
- Class B. 2-1 student to netbook access - three days per week for ten weeks.
- Class C. 2-1 student to netbook access - five days per week for six weeks; and
- Class D. 1-1 student to netbook access - three days per week for ten weeks.

The study was informed by Activity Theory (Engeström, 1987) as the conceptual framework, and employed a mixed method methodology (Onwuegbuzie, 2002). The research focussed on a variety of themes including mLearning, Ubiquitous Computing, Communication, and Classroom Environments. The research aimed to contribute to both practical and theoretical knowledge in the above domains. The study took place in a Queensland Non-Government Primary School. An initial survey of the Year Seven students involved in the study indicated that 95% of the students had computing and internet access at home. As a consequence, it was decided that the netbooks would not be taken home by the students.

The ubiquitous use of computers in a classroom adds a significant component to an already complex context consisting of multiple interrelated elements; e.g. teachers, students, curriculum outcomes, and classroom management practices. Consequently, this necessitated a research approach which accommodated the realities of complex environments (Tondeur, van Braak & Valcke, 2007). In arguing for the appropriateness of Activity Theory as a conceptual tool to analyse educational contexts, we propose that considering classrooms as complex systems allows the examination of the six key elements of such systems – namely subject, rules, community, division of labour, object and tool – all mediating the outcome of a goal. Taking this approach demanded an understanding that teachers and students were not 'units of analysis' (Shaffer & Serlin, 2004), but were "the key component in the establishment of social and cultural contexts which explicitly affect the phenomena under study" (Maxwell, 2004, p. 9). A mixed method approach allowed the investigation of what happened in the classrooms without disrupting their integrity.

Activity Theory, based on the Hegelian concept of dialectics, argues that the attempted establishment of dichotomous contexts (e.g. qualitative – quantitative; quality – quantity; hard – soft data), are neither helpful nor productive (Ercikan & Roth, 2006). From this perspective, an integrative, mixed method approach, capable of dealing with different elements of analysis e.g. individual, group, community and culture was required. Such a methodological choice afforded a range of options in terms of data sources, the analysis of data, and the generation of warranted findings which best suited

the research questions under investigation (Coupland, 2004; Ercikan & Roth, 2006; Gordon, 2006).

Data Collection and Analysis

As a mixed method approach is 'empirically omnivorous' (Freebody, 2003), it permits the collection of all manner of potentially relevant artefacts and events. Data were collected through:

1. Classroom Observations – including the use of the Survey of Computer Use (SCU) (Dawson, Cavanaugh & Ritzhaupt, 2008/2009).
2. Semi – structured interviews and student forums (Freebody, 2003; Garthwait & Weller, 2005).
3. New Classroom Inventory Index (NCEI) (Newhouse, 1997)
4. Data Logging Software on netbooks (Swan, Hooft, Kratcoski & Unger, 2005)
5. Participant Diary (Optional) and Researcher Diary (Sewell, 2006)
6. Anonymous, open-ended survey of all students at the conclusion of their netbook usage period.

Data analysis was undertaken throughout the study, enabling the early analysis to shape the subsequent data collection processes. Findings from the early analysis, reported here, involved transcribing interview data, and the processing of classroom observations and other artefacts (Garthwait & Weller, 2005). Data collected was coded into emerging categories of interest. Initially these were key Activity Theory elements noted, but also included other themes as they emerged; e.g. productivity and student behaviour. Initially, the data analysis process was based on the data collected from one teacher and one class. At a latter stage in the research, as other teachers and classes became involved in the project, these initial transcripts were re-analysed and triangulated with other data to determine new themes and new categories for analysis. Quantitative data collected via the NCEI, SCU, and data logging software, were analysed using the Statistical Package for the Social Sciences (SPSS Version 17), successfully utilised in a number of ICT related research projects (Mouza, 2008; Newhouse, 1997; Gordon, 2006). Management, coding, and analysis of the qualitative data was assisted through nVivo7 (QSR International).

Ethical approvals from Griffith University and approval from Brisbane Catholic Education (BCE) to conduct research in one of their schools were obtained. A key ethical consideration was the well-being of the students and teachers involved. This was particularly vital as the principal investigator was a member of staff at the school, and would have an ongoing relationship with both students and teachers beyond the completion of the research project.

Reliability and validity was enhanced via the employment of a number of strategies recommended by Creswell (1998). These strategies included triangulation of the data; an appropriate time spent observing and interviewing; the clarification and declaration of personal bias; and the decision to enter the research site as a participant rather than an observer. As a final check of validity and reliability, 'member checking' (Eisenhart & De Haan, 2005) was added whereby the principal researcher, after competing data analysis, returned to the site of the research and asked the participants, "Have I got this right?". Therefore, the teachers and students in the project were involved in all stages of the study and this helped ensure the accuracy of our interpretations.

Summary of the Major Findings

The summary provided relates to early initial findings, and these are presented succinctly, given the limitations of the length of this paper.

Research Question 1

Did varying the ratio of netbook availability – i.e. from 1-1 to 1-2 or varying the pattern of availability - i.e. five days per week for six weeks vs. three days per week for ten weeks effect student usage in terms of quantum (as a ratio of available time) and quality of use?

Usage was generally low across all four classrooms. The average usage per netbook per day were

- Class A (Average daily usage was 54.54 minutes per day or 18.18% of the school day (5 hours excluding breaks);
- Class B (Average daily usage was 90.44 minutes per day or 30.15%);
- Class C (Average daily usage was 56.10 minutes per day or 18.7%); and
- Class D (Average daily usage was 62 minutes per day or 21% - figures taken after 24 days of use).

Although each classroom received the netbooks for a quantum of 30 days, overall usage was higher in the two classrooms using the netbooks three days per week rather than five days per week. Usage was significantly higher in Class B but relatively consistent across the other three classrooms. There was no significant student use of netbooks before school. Availability affected, but did not solely determine, usage patterns. To illustrate, both Class A and D had 1:1 option available for each student. Class A always used the whole class model whilst Class D rarely used all the computers at one time. Similar usage differences occurred in Class B and Class C which only had 16 netbooks available for use. 16 netbooks seemed to provide the threshold of the number of computing devices for the teachers to significantly integrate computing into their classrooms. This did not necessarily mean 2:1 computing use, as teachers used a variety of models to ensure substantive 1:1 computing for the students.

Research Question 2

Did the specific "learning mobility and functionality" provided by the netbooks impact on their uptake by early adolescent students and are netbooks an appropriate solution to identified problems with laptops? -e.g. size, weight, battery life and cost (Rockman, 1997; Hill & Reeves, 2002).

Netbooks were considered an appropriate tool, by both students and teachers, to complete the tasks required by the teachers in this context and included the use of the following software - Internet Explorer, Microsoft Word, Microsoft PowerPoint, Microsoft Publisher, Microsoft Media Player and Microsoft PhotoStory. The preference of a significant majority of students was for netbooks rather than laptops due to their mobility, size, and impact on desk space. Students were reluctant to stop using the netbooks and enjoyed completing work on the devices. By way of illustration one student in Class A wrote "*It might slow down our work and I will be a bit sad that we don't have the computers to use every day*". There were minor issues with the 85% keyboard for students who were fluent typists. About 25% of students preferred to bring a mouse from home rather than use the trackpad on the devices.

Research Question 3

Did the opportunity for ubiquitous access to the netbooks effect student to student collaboration and types of classroom communication?

1:1 computing reduced the amount of group work completed by the students. This was particularly evident in Class A where netbooks were only used in a 1:1 context. Collaboration increased in classrooms with 16 netbooks as students were working in pairs on a regular basis. This was seen positively by students in these classrooms. Student preference in these classrooms was initially for 32 netbooks yet, by the end of the project 16 netbooks was the preferred option for all of the students interviewed in Class B and C. A student in Class C, who initially indicated in her initial interview that she thought 32 computers would be best, said this in her final interview "*I now would*

like the 16 because I want to work with my friends". Teaching and learning patterns changed significantly in classrooms with 16 netbooks and included increased paired work, 1-1 work and rotational activities and this required an additional commitment by the teacher to prepare significant scaffolding for activities to be completed on the netbooks.

The 2:1 'paired work' model was largely used when research / information gathering was conducted with the 1-1 model used primarily for 'work productivity' tasks. Classroom discussion diminished when netbooks were used (in this context, discussions were largely teacher focussed and directed). Students were less interested in teacher led discussions as they felt able to solve problems for themselves and were keen to commence the task. The quantity of teacher talk diminished as students were more likely to be given greater responsibility to self-manage the task. The students wanted less talk from the teachers, however, a negative aspect of this desire to work on their own was that it was difficult for the teacher to re-engage the whole group once the activity had commenced.

Research Question 4

Did the opportunity for ubiquitous access to the netbooks affect the classroom environment?

Behaviour management issues diminished and this was noted by both students and teachers. A male student in Class A wrote "*People liked using the computers but when we are writing in our books kids are going off task more easily*". Students 'on task behaviour' increased and there was little evidence of off task / inappropriate usage of the netbooks. A different student wrote "*behaviour is better when we are on the netbooks it is our own independent thing*". There was no substantial evidence of changes to individualised learning and little scope for students to decide whether or not to use the netbooks.

Student productivity increased. The amount and quality of work (at least in terms of presentation) increased and less student work was required at home. There was some anecdotal evidence of improvement in quality of student ideas. The use of the netbooks substantially increased the literacy demands on students. Access to information was a critical factor and such access facilitated knowledge generation, scaffolded activities, freedom from direct teacher talk and the opportunity for individualised learning. Students demonstrated increased engagement in learning as evidenced by parental report of students being more enthusiastic about attending school and by continued, positive feedback about the netbooks by students interviewed throughout the study.

Discussion

The following discussion is presented in terms of themes which emerged in relation to netbook usage. For ethical reasons, teachers are identified as Teacher A, B, C or D throughout this discussion.

Netbook Usage

The usage of netbooks was not ubiquitous in terms of the definition used in this study – namely the 'weaving of the technology until it is indistinguishable' at least not in terms of substantive usage of the devices each day. The average daily use of each netbook was 65 minutes per day or 22.5%, while the minimum daily average was 10 minutes or 3.42 %, and the maximum daily average was 164 minutes per day or 55.29%. It needs to be taken into consideration that there were significant periods of time when the netbooks were very rarely used including non-contact time, assemblies, Friday sport (total of +/- 7.5 hours), and Key Learning Area (Maths, Science, SOSE, H&PE) rotations (+/- 8 hours). If these time periods are subtracted from the overall available teaching time, the net effect is that the teachers effectively had an available 12 hours per week to use the netbooks. From our experience, this is similar to what occurs in Year Seven classrooms in many other schools. Therefore, in this study, the netbooks were used about 40% of the available time in Class A and C, 43% of available time in Class D and over 60% of the available time in Class B.

The usage was greatest in the classrooms which had the option of using the netbooks three days per week for 10 weeks and this usage was irrespective of whether or not the 16 or 32 netbooks were available. The teachers in these two classrooms had the opportunity to determine which three days per week were best for netbook usage in relation to other events (Non contact / sport / assemblies) which reduced their available classroom teaching time and were therefore able to choice the days which maximized their potential usage. The greatest usage, by far, was the classroom which had 16 netbooks and the option to choose the three days for their use with daily usage in this classroom 50% greater than the other classrooms. This suggests, from an economic point of view alone, that 16 netbooks, three days per week appears to be the most productive use of the netbooks in terms of maximising there usage. The pedagogic implications of this decision are also positive and will be discussed later in this paper.

Netbooks are Appropriate Technologies

The findings suggest that the netbooks were an appropriate computing device for the Year Seven students and teachers in this study. The netbooks were a robust, practical, cost effective device for the completion of computing tasks required by these teachers. The students efficiently completed word processing, presentations, publications and research tasks on the netbooks and incorporated sound and images into the work they presented. The school has a strong infrastructure in place in terms of wireless connectivity, bandwidth, data management, wireless printing, and on-site technical support. Such a strong infrastructure is critical in overcoming 'first order' barriers (Ertmer, 1999). First order barriers are those which are extrinsic to teachers' control. A clear implication from this study was that a majority of students (N=125) were proficient at typing and, almost without exception, preferred typing to writing. The students primarily learnt to type through the use of MSN or other social networking sites and were more willing to edit computer based work rather as opposed to their handwritten work. This was viewed positively by the teachers who noted an increased willingness by the students to conference with them regarding their work, and then edit their computer based work appropriately.

Influences on Patterns of Usage

Patterns of usage were influenced by the physical allocation of the devices, and by the teaching philosophy of the teachers involved. These factors influenced the level of student collaboration. As reported elsewhere (Donovan, Hartley, & Strudler, 2007; Zucker, 2004), the pedagogical decisions of the teacher were a key factor in the computer usage in the various classrooms.

In this study, both Teacher A and Teacher B had unlimited access to one netbook for each student in their class. Whenever Teacher A determined it was appropriate to use the netbooks, each student used their own netbook. He repeatedly commented that since he had unlimited access to a powerful resource he should use them to their fullest extent. He was also conscious that he had the netbooks for a limited period of time. Teacher B, on the other hand, used them to support and extend pedagogical structures already in place and rarely used all the netbooks at the same time.

Teacher C initially attempted to use the 16 netbooks as a whole class activity, but was dissatisfied with the productivity of the students in a 2:1 model. He changed his approach and only used the 2:1 model when the research neared completion. Teacher D immediately used the 16 netbooks available to her in a 1:1 scenario. Half the students used the netbooks individually, whilst the other half worked with her. The students then swapped activities.

Both Teacher E and Teacher B indicated that 16 netbooks were sufficient for their students. Teacher C identified that 16 would be appropriate but that he would need to further adapt his teaching to better utilise the pedagogic advantages of using 16 netbooks. Teacher A was insistent that 32 was the best model as it provided great flexibility for him as a teacher, and for the students as learners. In summary, the pattern of usage significantly shaped the pedagogy of two of the teachers, supported the preferred style of one of the teachers, and did not significantly affect the fourth teacher.

In relation to the classrooms with access to 16 netbooks, this 'limited availability' encouraged and afforded a 'split teaching' model where students alternatively worked individually on netbooks or with the teacher for short periods during the day. This was a positive experience for both students and teachers although it required the commitment of the teacher to complete activities more than once. One of the students in Class B commented that, "*Yes, I think he [the teacher] has to work harder as he has to teach it twice but then it is a benefit for us*". One of the teachers, who had full availability of the netbooks, chose to limit the number of netbooks used by the students. The potential bonus for teachers using the netbooks in this way is increased student engagement and a more positive educational experience for both teacher and students.

Netbooks and Collaboration

The use of the netbooks substantively affected the level of collaboration in three of the classrooms and in a less significant way in the fourth. In the classroom which used the netbooks all at once, the level of student collaboration significantly decreased. When the students were using the netbooks in that class, they preferred to work individually on tasks and were almost singularly focussed on completing set tasks. They preferred, and required, less instruction from the teacher whose role was largely to support individuals in the completion of the task. The teacher saw no benefit in paired models of usage as the netbooks were available for 1:1 work. In the second classroom with 1:1 access, the level of collaboration was largely unaffected. The students used the netbooks on an individual basis with limited collaboration largely concerning technical, "how to" issues.

In contrast, levels of student collaboration increased markedly in both the classrooms which used 16 netbooks. The access to 'only' 16 netbooks encouraged and resulted in an increase in the amount of paired work. The teachers tended to use the 2:1 model for initial brainstorming, research, and joint presentations, and switched to 1:1 usage for writing of narratives, or preparation of brochures. Task selection was critical in determining whether a 2:1 or 1:1 approach was required. Students noted that they enjoyed paired work on both a social and academic level and that prior to using the netbooks they did not work in pairs. A female student in Class C stated that, "*there is more talking about work with the netbooks than if we were just working in pairs in our books*".

Changes in Classrooms

A substantial, observable, and positive change occurred in classroom behaviour, across the four classrooms, when the students were using the netbooks. This change was commented on by both teachers and students. Students were largely 'on task' whilst using the netbooks and this might be explained in two ways. Firstly, the students were able to "*produce work of a high presentation quality and felt proud of their efforts"*. They felt that they were doing more work than they would have done without the netbooks but also felt that, as a consequence, they were required to do less computing work at home. There was also some anecdotal evidence from the teachers that the quality of ideas had improved as a result of the netbook use. Secondly, the students "*enjoyed the opportunity to use the netbooks"* and much preferred this to handwriting. Because of these factors, the teachers were able to spend more time in conferencing or smaller group teaching.

Whilst student behaviour was observed to have improved, and the students were more productive, there was no change to the amount of individualised learning of the students. One teacher effectively used the netbooks as an electronic textbook whilst other teachers used the netbooks to support rotational activities. In all of the classrooms, the students were working on similar tasks. There were very few learning episodes where students could decide whether or not to use the netbooks. Despite not being able to decide when to use the netbooks, the students reported and demonstrated a high degree of enthusiasm throughout the project. Although their use was only for a term, this enthusiasm did not wane. All of the students reported that they valued the experience and would like to continue to use the netbooks if the opportunity arose. A student in Class C wrote, "*Next term I think that there will be an empty space inside of me and that I will really miss them*".

The classroom environments were also changed as a consequence of significant access to

information. This substantial increase in access to information was a critical factor in the study and afforded the opportunity for students to significantly investigate a range of topics in greater depth. This effectively freed the teacher from being the central provider of information. Both students and teachers commented positively regarding the increased access to information.

Conclusion

As schools move increasingly toward 1:1 computing, the findings reported here provide guidance for informing schools which might be considering acquiring netbooks. The implication from this research is that the most appropriate usage pattern for the netbooks was 16 per classroom for three days per week. This pattern of usage had substantial pedagogical advantages and appeared to afford the best balance between individual student productivity, student collaboration, direct teacher instruction and flexibility to respond to other curriculum and non-curriculum events. It was also the most economically viable alternative in terms of quantum of usage. The class set or half set of netbooks provides a 'critical mass' of computers which is not present in many current classroom models of computer use where three to four desktop computers are typically allocated per classroom. The research suggested that the availability of only three to four desktop computers was not sufficient to generate anything other than superficial use and that, for the students in this study, these computers were largely redundant to their needs with the majority of computing work completed at home. A more productive use of limited school resources might be to purchase sets of 16 netbooks shared between two classrooms rather than the current practice of positioning three or four desktop computers in each classroom. To conclude, the netbooks were clearly a robust and appropriate device for the computing needs of the students and teachers. There were limited issues with the netbooks and their size and portability were considered a significant advantage by the students and teachers in this study.

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