NEA05582

Student reflections on the effectiveness of ICT as a learning resource

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Paper prepared for presentation at the AARE Annual Conference Parramatta Nov/Dec 2005

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Abstract
Direct investigations of student opinions about the use of ICT and learning are generally missing from the literature. This paper reports on a study that captured the reflective voice of students to investigate what is truly happening in Victorian schools. The focus of this study was the student learner and how students think about their own learning. The study identified key contextual factors that influence the learning process and, in conjunction with ICT, change the learning opportunities for students. The analytical framework in this paper captures the relationship between the substantive factors including the learning culture, social well-being, motivation and engagement, and thinking and learning strategies.

Background

A key role of education is to empower students with skills and attitudes that are essential to their success in our knowledge society future. Cuttance (2001) suggests that new ways of thinking and solving problems in supportive classroom learning environments require well-developed motivation, self-regulation strategies and metacognitive capacities to engage students successfully.

A central aim is to ensure students, such as those in the middle-years, acquire essential information skills (Barratt, 1998) appropriate to the knowledge society, and to nurture modes of learning, or learning styles, such as visual, auditory and kinesthetic (Hinkley, 2001) to maximize the learning potential of individual students. This means that a new challenge confronting education is concerned with meeting the needs of *all* students: personalised learning where learning is designed around students needs (Hargreaves, 2004).

Hargreaves (2004) highlights the importance of 'nine gateways' to personalising learning—curriculum, workforce, organisation, student voice, mentoring, advice and guidance, new technologies (ICT), assessment for learning and learning to learn, with each potentially "enhancing student motivation and commitment to learning" (p 7). This paper is concerned with two of the aforementioned gateways to personalising learning: student voice the use of new technologies (ICT).

It would be meaningless to say we are personalising learning unless we involve them [students] in the process" (Hargreaves, 2004:10). Practices that focus on designing curriculum experiences have been encouraged as central features of reform initiatives to improve the quality of learning in schools. The use of student voice benefits teachers and therefore possible changes to teaching practice and curriculum experiences.

In this context, this paper considers student voice from middle-years students (early adolescents), Years 5 to 9, from Victorian Government schools. The voice of students is able to make a significant contribution to what they regard are important factors, particularly with the use of ICT, that affect learning. Furthermore, the need to consider personalised learning adds to the importance of identifying with students in an effort to improve student performance.

Using student voice

School reform and changes that ensure sound pedagogical practice are no guarantee that students will engage in the education process (Munns, McFadden, & Koletti, 2003). If students are to engage with school and learning there needs to be consideration from student discourse to elaborate on their underlying recognition of what productive pedagogy truly motivates and engages them in learning.

Direct investigations of student opinions are missing from the literature and there is little known about how students think about their own learning (Fletcher, 2003), particularly in relation to technological innovation in learning environments (McLoughlin, 2000).

Student voice is important because:

> presenting the research focus from the individual stance, using the voice of the researched as far as possible, the research comes alive, transforms from the removed to the dynamic and allows for commonalities of experience as well as the differences or unique qualities between individuals (Green, 2002).

Using student voice to discover personal perceptions of subject matter, the teacher and teaching practices, and of the cultural and social circumstances (key aspects of the milieu) will significantly add to the body of knowledge about individualised learning *with* ICT in school environments.

It is easy to believe that ICT has a positive influence on learning and many parents and teachers are convinced ICT offers better learning opportunities than 'traditional' approaches. The large financial commitment in schools and homes is evidence of the positive thinking about ICT and its potential to improve student attainment. For many students the novelty of the equipment is a motivational factor in their learning. The attention should, however, be focused on whether the ICT is engaging the student and enhancing the learning.

The contemporary understanding of learning emphasises the importance of prior knowledge, an active approach to learning, relevance, social construction of knowledge, individual metacognition and self-regulatory strategies. These constructs shape, in turn, pedagogical practice and the organisation and management of learning. The focus of this new learning is very much about meeting the needs of the individual learner.

Models of school learning, constantly refer to students as an integral part of the process (Bruner, 1985; Kolb, 1984; Muth & Alvermann, 1999). An analysis of research findings from nearly two hundred studies of K-12 classrooms identified practices with the strongest impact on student learning (Cuttance, 2002). These school or teacher influenced practices include classroom management, development of meta-cognitive and cognitive practices, and student and teacher interactions. Other factors, which have a lesser impact on learning, include design and delivery of curriculum and instruction, classroom climate and organisation. However, these latter considerations

are necessary to create and sustain the environment in which "the strongest effect can be implemented" (Cuttance, 2002: 6).

Effective learning, therefore, requires that attention be given to the needs of the individual learner, that teachers have a sound understanding of how learning occurs, and that school structures facilitate and enhance learning opportunities including the use of contemporary learning tools.

The process of collecting suitable data

The decision was made to carry out an ethnographic investigation. Two relevant Australian studies using student reflections included McLoughlin's (2000) use of student voice in distance education; and Clarke's (2001) comprehensive work on students' perspectives in mathematics and science classrooms. This study, like Clarke, enables "the individual's construal of those events, the memories, beliefs and attitudes invoked, and the meanings and practices which arose as a consequence."(Clarke 2001: 15).

Atkinson and Hammersley (Denzin and Lincoln 1994) state that ethnography usually refers to forms of social research with the following features:

- a strong emphasis on exploring the nature of particular social phenomena, rather than setting out to test hypotheses
- a tendency to work primarily with "unstructured" data ,
- investigation of a small number of cases
- analysis of data that involves explicit interpretation of the meanings and functions of human actions, the product of which mainly takes the form of verbal descriptions and explanations, with quantification and statistical analysis playing a subordinate role at most (Denzin and Lincoln 1994: 248).

This research endeavours to see what is happening and what presently exists, rather than what could exist, where 'qualitative researchers are non-interventionists' (Stake 1995: 44). Miles and Huberman (1994) argue that qualitative data are a source of well-grounded, rich descriptions and explanations of processes occurring in a local context. The intent of this research was to observe long enough and to analyse what was happening in ordinary, natural circumstances (i.e. classrooms). It allows the issues to emerge from the many pieces of interconnecting evidence.

The key methods selected with this research include:

- observation in middle-years classrooms as the central technique;
- interviewing (including the use of video-recall scenarios) students; and
- photography as a means to collect factual information in a visual form.

The use of a case study approach to examine student perceptions of learning with ICT became apparent as this study unfolded.

Selection of schools and students

In the initial stage of this study seven schools were selected in the case study. The seven schools made classroom observations possible that allowed the researcher to record initial assumptions about learning within ICT environments and began the

process of establishing relationships with teachers and students. Interviews with individuals were undertaken after classroom observations throughout the study. As the research developed and issues emerged a smaller number of classes became the qualitative focus for more intensive investigation. Whilst good data can be gathered using informal conversation during and after participant observations (i.e. unstructured interviewing), the decision to undertake semi-structured interviews in this study was designed to gain rich data from individual students and to allow opportunities for the researcher to explore and probe further. Interview guides were utilised to ensure certain topics were dealt with and typical questions were covered (Kurz, 1983). This occurred with 32 students over time, 16 initially in Year 6 and 16 initially in Year 7. Interviews were repeated with the same students in the following year after their transition into a new school or after their transfer into a new class.

The final part of the investigative study concentrated on the use of 'video-recall' events for 16 of the students to reconstruct orally their thoughts and actions. This technique included the use of captured video of students in the secondary classroom that was replayed to them after the observed lesson. This approach recognises aspects of Clarke's (2001) methodology that undertook rigorous study combining videotape data with participants' reconstructions in mathematics and science classrooms.

Selecting this research procedure enabled the researcher to probe the student's reflective thinking, using video as a stimulus and invited students to explain specific learning moments. In addition, other audio-visual methods, including the taking of photographs at opportune times, captured a visual record of the students in their natural setting (Bogden & Biklen, 2003).

A focus on new technologies (ICT)

There is a broad optimism that ICT can and does support the kind of learning appropriate to the information age. For example, the ease of the technology frees up time for higher-order learning opportunities (Brown, 1994), it supports meaningful learning (Jonassen, 2000) and student autonomy (McLoughlin, 2000), at risk students are more likely to engage in literacy tasks (O'Rourke, 2001), it promotes active learning (Meredyth, Russell, Blackwood, Thomas, & Wise, 1999) and will enable the user to do new things rather than just old things better (Snyder, 1999). Furthermore, it is argued that computing technologies appropriately coupled with other educational innovations can increase the efficacy, efficiency, and extent of student's self-regulated learning (Winne & Hadwin, 1998: 108).

The introduction of ICT does not, however, guarantee better learning for *all* students and not all researchers agree that educational technology is a panacea. Access to computers and the Internet does not mean new learning methods suddenly emerge. As Schacter (1999) points out, "we should not accept the rhetoric that technology makes learning easier and more efficient because ease and efficiency are not prerequisite conditions for deep and meaningful learning" (p 331).

If the inclusion of ICT is to be utilised effectively to engage middle-year students, it should be expected to provide a better option to the practices it is to replace. Given that we know interest levels decline throughout the middle-years of schooling (Hill &

Russell, 1999), educators also need to develop pedagogical practices that capture and focus student engagement.

Advocates for the inclusion of ICT in pedagogical practice argue that it has the potential to encourage critical and reflective thinking for individuals to attain personal goals. In a supportive (constructivist) environment, the use of ICT promotes student autonomy whilst also providing opportunities to work collaboratively with others, that is, practices that promote deeper cognitive opportunities and engage the learner in intellectual activities with some control over learning. This includes learning attributes described by Meredyth et al (1999) as "capacities such as self-regulation, self-discipline, collaborative learning and creative thinking" (p 228).

Approaches where ICT is used to support learning has been found to benefit the affective learning domains (attributes such as motivation, perseverance, etc.) by improving student engagement to tasks (Jacobsen, 2001), improving motivation and enthusiasm (Mandinach & Cline, 1996), and improving attitudes to learning (Ryser, Beeler, & McKenzie, 1995). While it is difficult to assess the direct impact of the affective domain on student learning outcomes, it is widely recognized as an important correlate of effective learning. Research on the impact of ICT consistently reports that students who have regular access to and use ICT demonstrate considerable improvements in these affective areas (Ainley, Bourke, Chatfield, Hillman, & Watkins, 2000; Calnin, 1998; Cuttance, 2001; Schacter & Fagnano, 1999). It is axiomatic that none of these benefits is guaranteed to flow automatically from the use of technology, but many may be achieved through good teaching and the modeling of effective learning.

Along with the gains in the affective domains, research is consistent about improvements in the learning environment. The learning environment is not a factor that can be directly related to achievement gains, but like the affective domain, remains an important correlate in student achievement. When ICT is used in the classroom it creates more opportunities for individualised and differentiated curriculum (Calnin, 1998), there is increased student collaboration (Thompson, 2004), it increases self-management and self-regulation as learners (Cuttance, 2001), and relationships between teachers and students are more interactive and guiding, rather than one of transferring information from teacher to student (Shears, 1995). The critical factor in supporting effective learning with ICT is to focus on the way it is integrated into classrooms.

When using ICT the hope was that it would be a tool capable of changing the characteristics of problems and learning tasks, and hence be a mediator of higher cognitive skills: synthesis and analysis, critical thinking, evaluating, hypothesizing, questioning, observing patterns, making generalisations and problem-solving strategies. Authors such as Cuttance (2001) and Schacter (1999) conclude that ICT will yield positive gains in student achievement, and Scardamalia & Bereiter (1996) report effective ICT use can support depth of understanding and reflection. Large scale British research provides data that shows students in an ICT environment demonstrate domain-specific attainment gains (British Educational Computing and Technology Agency, 2004). However, the research and the correlation between ICT and student attainment is equivocal (Development Gateway Foundation, 2005).

Advances in technology will not make current teaching methodologies redundant. Rather, ICT should be grasped and applied in imaginative and creative ways to enhance cognitive learning for students (Gilliver, Randall, & Pok, 1999). The teacher's awareness of the way an individual student will benefit from different learning experiences contributes to enhancing the learning process. The effects of the teacher and instructional styles constantly impact on students as they consciously and unconsciously gain new skills and knowledge.

By drawing together the literature that has focused on the role of ICT, the middle-years of schooling, and contemporary understanding of learning, key factors that impact on and shape effective learning have been identified as learning culture, social well-being, motivation and engagement, and thinking and learning. The relationship between these factors and the approach to learning has determined the *analytical framework* shown in the Table 1.

Table 1: Students approach to learning in the middle-years

Factors influencing student learning (learning process)	**APPROACH TO LEARNING** **Surface** ⟷ **Deep**	
Learning culture	Teacher-centred Transmission of knowledge	Student-centred Self-directed learning
Social well-being	Low self-efficacy Peer pressure/alienated	High self-efficacy Social interaction
Motivation and Engagement	Extrinsic Intention to complete tasks	Intrinsic Intention to understand Integrating knowledge
Thinking and learning	Low level thinking	Higher cognitive strategies

The goal, in each of the factors, is to enrich the student's approach to learning with the qualities associated with surface approaches with those of deep approaches. Deep learning strategies involve transformational processes that link new learning with past learning and are supported by intrinsic motivation (Ainley, 1993). Cognitive skills most appropriate to the knowledge society are those associated with deep learning. Such skills include higher-order thinking strategies: seeing connections between ideas and patterns, applying metacognitive skills, and the application of the skills of analysis, synthesis, evaluation, reflection and problem-solving. Deep learning is more likely to emerge from authentic learning experiences particularly when students are intrinsically motivated to learn.

To comprehend and capture the relationship between the factors, the use of student reflections describes how students think about their learning, and the effectiveness of ICT as a learning resource.

The learning culture and ICT

The learning culture encompasses such things as school setting, the influences of different groups of people within the organisation, curriculum management and delivery, values and traditions, and the school's place in the community. The

provision of ICT as a learning resource/tool has created challenges for schools. In the first instance, the manner in which ICT can be deployed is determined by the school's infrastructure, finances, classroom physical space, personnel and technical support. Individual schools adopt different organisational models—computer laboratories, computers interspersed in classrooms, individual laptops, or pods. Clearly these decisions impact on pedagogy and therefore the nature of learning and the learning culture.

Students identified some of the major influences that impact on the learning culture of a school. Through student-voice, the most critical aspects identified by students were: the impact of school structures between primary and secondary systems; access to technology; the continuity of skills and knowledge across curriculum domains; and the positive and negative impact of using ICT.

Curriculum frameworks and organisation are key determinants of a school's learning culture. Curriculum continuity deals with the seamless development of learning outcomes across the middle-years spectrum. Primary teachers generally adopt an Integrated Curriculum approach (Murdoch, 1992; Wilson, 2003) that combines several key learning areas. The issue of curriculum continuity arises as part of the shift from an integrated curriculum in the primary years to the subject-discipline approach undertaken in secondary schools. Although a curriculum framework exists, the organisational shift from primary to secondary schooling is an impediment to continuous developmental learning. Secondary schools timetable blocks of time for students to spend time with teacher experts and are exposed to specialist subject knowledge (McInerney et al., 2001). New secondary students explained the learning situation and initial experiences with the secondary curriculum.

> *You change a lot because you have different ways of learning. You have periods and move to different classrooms instead of having the same teacher*[1].
>
> *You have different subjects and all so you have to go to different class practically every period and it's really different.*

The lack of curriculum continuity affects academic adjustment and the quality of learning during the shift is a concern (Huggins & Knight, 1997). How schools make decisions about the placement of ICT resources also affects student learning. The two main issues raised by students were in regard to computer access and opportunity. From primary students there was consensus that the placement of computers in the classroom provided some regular access.

> *We only have one computer in our room and the computer room is normally full.*
>
> *We had six computers in our room.*

The main form of computer access observed in secondary schools was in computer labs. In fact, the main access for some classes in some secondary schools is restricted to Information Technology classes only, and these were further restricted in a timetable that provided class access within different school semesters.

> *Last semester we did a class called Computers where we were taught how to use different programs.*

[1] Each quote is taken directly from an interview transcript with students from my Doctoral study.

On our timetable we have about three classes a week in computers.

In Year 7 we had computer classes. I'm not sure if we have them again next semester.

This situation provides limited access for classes of students to ICT. Given the subject-based approach of secondary schools, a good deal of reliance is placed on the timetable to provide an effective learning environment. The timetable provides students with a structure that determines which subject lessons are taught at different times of the day. In some secondary schools the introduction of laptop programs and the use of pods (banks of computers) are further options to provide more regular access to ICT and therefore make *a difference* to learning opportunities.

Evidence from students demonstrate that the within the learning culture the teacher and the use of ICT has both positive and negative consequences for different learners and their learning styles. Given that early adolescents are generally keen users of modern technology, many students enjoy the novelty of the resource, value its efficiency, or are motivated to explore and experiment with various applications. On the other hand, some students are frustrated by their own perceived inabilities using different technology tools, or have low expectations accessing school resources to adequately support their learning.

With English we do projects on them [the computer]. In music even, we did an assignment on the computer…we got to use the Internet and go on like all these music sites.

I enjoy making the programs, seeing the programs work once you've typed them in.

[I] didn't want to come to school but with more technology, now I want to come to school and do stuff on the computers.

For some students, interest with ICT wanes over time as they become more familiar with the technology (Kendl, 1992). One example is highlighted:

I like making the PowerPoint presentations on them. I get a lot of fun out of that with all the backgrounds, different colors and pictures and that.

Six months later, the issue was raised again with the same student:

I did a lot of PowerPoints in Grade 6. It's pretty boring PowerPoint. It's just all these different colored backgrounds with all these moving pictures on them.

Like any tool, the constant repetition of the resource contributes to lessening the learning pleasure. The 'newness' of the Internet has been further hampered by the need for restrictive policies. For many students, and some teachers, the restriction of sites can be an imposition on learning.

It has web sites and stuff and if you want to look up more information and that…but they're all blocked on our computers.

I could get into Yahoo and I could look up "teak" but there's 20 sites listed and all 20 sites are blocked from the school.

The Internet restrictions at schools prevent student learning opportunities that may well be otherwise available in home environments. The issue of home access to ICT further compounds the role of the school and the impact on student learning within classroom environments.

> *I find it (the Internet) slower than at home and it takes longer to find stuff…and I'm not as comfortable with it because I don't know it as well as our computer at home.*
>
> *I can always go home and look up stuff on our computer.*

The issue of home access to ICT further compounds the role of the school and the impact on student learning within classroom environments. Access to computers in the home often includes more freedom to accessing Internet sites.

The positive and negative aspects of the use of ICT, as seen above, impact on effective learning for all. What becomes apparent from all these situations is that the role of the teacher plays a significant part of the learning potential when using ICT in the teaching-learning process.

Teachers' subject knowledge, pedagogical skills, discipline, and enthusiasm are important determinants in establishing and maintaining the classroom learning culture. For most students who were asked, they value the teacher who is able to support them to integrate the technology effectively with their own knowledge-base.

> *One of the teachers doesn't know how to really use the computer, so she doesn't understand if it's hard or not. She'll say, "Well, you should have done it by now", but doesn't know how hard it is. I gave her a disk one time and she wouldn't accept it. I had to take it home and (re)type it up.*
>
> *Some of our teachers don't know how to use a computer, so they really can't help us out when we're stuck, so a lot of the boys in our grade help us out.*

The remarks from the students suggest teachers are needed to support the students to deal with technical matters associated with ICT, and to understand the degree of effort put into the use of some applications.

Social support and success in learning

Rowe (2002) and Kindermann (1996) report that students who experience support from their teachers are more likely to be engaged in learning. Regardless of the teaching methodologies, what remains critical to good learning is the quality of the relationship between student and teacher (Pomeroy, 1999) and student support of one another.

> *I like having one teacher for a lot of subjects. Like we have [teacher] for Science and Maths and as our form teacher. I think it helps a lot more when you know the teacher a lot better and they kind of understand how you work.*

In the given example the student identified the value the teacher brings to understanding his/her needs as a learner, and as a developing adolescent the importance of the relationship between him/herself and the teacher.

A major constraint on developing relationships with teachers in a subject discipline environment lies in the restrictive nature of the timetable. For example, one Year 7 student remarked; *Because you've got the primary school teacher for nearly every class, here you change around that much they [teachers] don't get to know you very well* . This was supported by another comment: *[With] less teachers…you get to know your teachers better, whereas if you have heaps of teachers, one for each different subject, you don't really get to know them as well.* Both comments show the value the students place on having a good working relationship with teachers that contribute to more effective learning.

The timetable is a main source of contention for effective learning (McInerney, Hattam, & Smyth, 2001; Nixon, Martin, McKeown, & Ranson, 1996) and reform efforts (e.g. Middle Years Research and Development) suggest more contact time between teachers and students can improve relationships and lead to better understanding of students' learning capabilities. This will have an impact on teacher support for students.

Schools and teachers will often deliberately set up computers so as to support peer-learning situations. Such learning opportunities play a major part in constructing a student-centred learning environment (Sandholtz, Ringstaff, & Dwyer, 1997) and affords opportunities for collaborative modes of learning that lead to learning gains (O'Rourke, 2001; Thompson, 2004). The idea is to have at least two students purposefully sharing one computer. The shared arrangements, according to one teacher, are deliberately implemented to encourage students to *scaffold learning, share ideas and assist each other when using ICT.* Students provide evidence about the impact of having to work with a partner. There are those who appreciate the support,

> *I think it's more fun if you work with others because you get a few laughs out of it. It's easier to think up heaps of ideas*.
>
> *Probably only have one computer, because then you could say, try this, or that didn't work, I've got an idea now try that.*

and those that prefer their independence:

> *Alone, because that way it's your own choice again. I find it easier to work by myself than have someone saying they won't do this, or, do that.*
>
> *You'd learn better on your own, but if you needed help I think you should do the same thing, but use two computers.*

Working with partners requires negotiation and collaboration. For some students, the sharing of computers presents as an inconvenience and their sense of autonomous decision-making is affected. However, a key finding according to all of the students is that the use of shared arrangements with the computer is dependant on the particular task at the time. It is succinctly stated by one student:

> *Depends what I'm using. Sometimes I like to work on my own. When I'm using Word and typing up a story I like to be alone, so I can think properly. But if I'm looking for stuff on the Internet, looking for stuff for projects, I like to be with people.*

The indications from all of the students highlight the value they place on working interdependently or independently. The independent approach allows them *choice* and enables them to work their *own way.* Some students prefer to be autonomous as its *better on your own* and *you get more stuff done.* In making the decision about working with a partner or not, one student sums up that working independently provided better learning: *I like to get things so I know about them,* whereas with a partner he feels he *just go[es] along with them.*

Students' peer relations are influential on their social development and can also be regarded as influential in their motivational development (Kindermann, McCollam, & Gibson Jr., 1996). This influence is a part of the culture that early adolescents deal with in daily classroom and learning experiences. It is the relationships students develop that contribute to their emotional state, and positive attitudes and self-esteem are important preconditions of effective learning. The need for healthy relationships with peers and adults remains important to the vast majority of middle-years students and contributes to their self-esteem and positive attitude toward learning.

Motivation and engagement

Research indicates that declining attitudes and motivation toward learning among our middle-years students is a serious issue (Anderman & Maehr, 1994; Dweck, 1996; Russell, 2001). Student recollections of their learning experience uncover intrinsic and extrinsic motives that have an impact on their engagement to learning. The focus, however, is on intrinsic motivation as an essential precondition of more effective learning. Intrinsic motivation is based on the "satisfaction derived solely from the qualities of the activity or its consequences" (Carter et al., 1996: 155).

A primary intrinsic motivator is when students are interested (as a characteristic of the person or of the learning environment) as this increases their willingness to learn. Interest increases students' attention to task, and they show greater concentration and enthusiasm (Ainley, 2001). One of the consistent messages from research (Braggett, 1997; Cormack, 1996; Cumming, 1996; Earl, 2000; Hill & Russell, 1999; Lee & Smith, 1993) has been the problems associated with student alienation and disengagement within the middle-years of schooling. Developing classroom strategies which activate the intrinsic motivation of middle-years' students has become an important goal in education. Student-centred classrooms that promote authentic learning tasks, provide active learning opportunities and incorporate ICT are strategies that have been developed. A review of student voices highlights classroom practices that represent some of the attempts to intrinsically motivate and engage them in learning.

> *We're doing a project thing on the computer and I'm doing mine on motorbikes. It's just easier because you can draw it and takes a lot less time I think.*
>
> *[The teacher's] given us topics and said that we can design our own activities.*
>
> *Some teachers say, "Okay in this unit we're doing this… is there anything else you would like to do?"* [25]

> *When you're in groups you can use, instead of having one person's knowledge you can have two people's knowledge.* [80]
>
> *I was focusing there on the picture and the information we had found. Then I was reading the notes my partner wrote.*

The evidence from the students supports activities such as project work, group work, problem-solving, and reflective thought (Ravitz, Becker, & Wong, 2000) that are key parts of student-centred learning. For these students there is genuine interest in learning.

Often, middle-years students are encouraged to learn for extrinsic motivational reasons such as exams or tests which provide a powerful incentive to work (Gipps & Stobart, 1993).

> *Instead of writing down a project you can type it up. It's tidier and you get better marks for presentation. [60]*
>
> *I did one (project) in Geography and SOSE. When I was doing it I ended up typing it all out on the computer. It looks better. You get better marks.*

The student comments show that they are aware of strategies that reward their efforts. However, the compulsion to complete the tasks implies the quality of the learning experience will be minimal and unlikely to inspire the students to understand. If the main motive is to do the learning because you *have to* there is unlikely to be any long term learning gain.

> *I didn't get much out of it. There weren't many answers, like there weren't answers at the end of it like you could tick or cross if you got right or wrong. That for me is how I know I've done well or not.*

From this evidence, the final product continues to be seen by many students as the most important part of the learning process. However, research indicates that the use of ICT can develop new forms of learning and ICT into schools has helped to create environments that are more relevant to our information economy (Department of Education Training and Youth Affairs, 2001): aspects of student-centred learning.

In student-centred classrooms there is a focus on individual learning where students are in more control of their learning, use social collaboration, and accept the teacher as facilitator rather than as transmitter of knowledge. It is hoped that the technology will actually change the characteristics of problems and learning tasks, and hence play an important task as mediator of cognitive development, enhancing the acquisation of generic cognitive competencies as essential for life in our knowledge society.

The fact that virtually all students believe computers enable hands-on opportunities because they physically push buttons, control a mouse, move the cursor, use different software applications, explore the Internet by following prompts, and comprehend (or not) what's moving on the screen (as opposed to the still text of a book), can change cognitive skills.

> *A computer…it's just more fun. In a book…just the way they pronounce it it's really boring, but on a computer it's like really colorful and stuff. Some of the web pages and everything, you can click on things and they pop out on the page, instead in a book it's just a page with writing.*

> *I suppose the difference is without computers you're just doing it on paper and reading. On computers you're doing it hands-on.*

The computer gives the students a sense of ownership of the task at hand. For some students, the hands-on experience with a computer is an intrinsic motive that is sufficient to engage them in learning tasks. However, it must be realised that the use of ICT as a preferred learning approach does not suit all learners.

> *... if you're reading out of a text book the information's just there. You can't ask any more questions. Same with the computer. But, if you're having a class discussion you can raise your hand and ask the teacher what you want to know. With the others you can't do that.*

The use of technology creates a different learning approach, resulting in different attitudes to learning, levels of motivation and engagement, and therefore different attainment levels. Cuttance (2001), Schater (1999), Calnin (1998) and British Educational Computing and Technology Agency (2004) conclude that the use of ICT will result in positive gains in student achievement. However, one of the key difficulties in determining shifts in thinking and problem-solving is that they are difficult to measure.

In order to ascertain whether students are being provided with opportunities to utilise higher-cognitive skills, a deep learning approach where the intention is to understand, is considered vital to enhance learning, rather that a surface learning approach where the intention is mainly at completing tasks. (Bowring-Carr & West-Burnham, 1997; Entwistle, 1995; Ramsden, 1992)

Thinking and learning approaches with ICT

Students' recollections of learning can provide evidence of whether the student is engaged in surface or deep learning. Surface learning approaches include tasks that involve low-level thinking, primarily those consisting of reproducing information, memorising information or where the student's sole intention is the completion of the task. When the given tasks demand more than routine effort and demand the use of higher cognitive strategies by challenging the students' thinking, these are considered to be deep learning approaches. Deep learning approaches include the intention to understand, relating previous knowledge to new knowledge, and discovering relationships between ideas.

Critical to engaged learning, with the use of ICT, is a constructivist perspective that emphasises student-centred learning environments where teachers foster and nurture more autonomous forms of learning. There are clearly definable instances from student recollections that outline the learning approach with ICT that is occurring in middle-years classrooms. The majority of comments obtained from students provide evidence of the dominance of surface learning approaches in classroom learning situations.

> *All the stuff we wrote down we have already learnt. We wrote the rough copy and we were just typing it.*

> *...notes we took out of books and just typed them up.*

Because you can cut and copy things.

Our teacher…gives us a set subject and gives us web sites to go to.

Where the sole objective is the intention to complete the task, ICT can be used to ease and to expedite the process.

I usually copy it but then I re-write it. I delete some of the words and put it in my own words so it looks like I understand it.

We went to the headings and looked for the key words. When we found the sentence we needed, it had like answers all through it and we wrote them down on the sheets.

The surface learning examples above demonstrate how the ICT applications are used for basic cognitive tasks. For example, where the student is retyping text, the thinking has predominantly occurred prior to the typing. These types of task do not amplify student thinking and require low level thinking skills—a surface learning approach.

The surface learning approaches described by students may be appropriate if they are aware that this approach enables them to succeed, such as with information gathering, or if presentation or speed are perceived by the student to be part of the assessment. However, it may not be a suitable approach if the students were required to show their 'true' level of understanding. In many school situations learning tasks only demand surface approaches as this fulfills the expected requirement. To demonstrate, or at least have the intention of understanding, a deep learning approach is desirable.

Deep learning approaches encourage students to understand new learning by challenging prior knowledge, experiences and perceptions. Where middle-year students are intrinsically motivated by the learning process, or by the content being studied, they will be active rather than passive in the learning task. Examples of the different types of thinking that occur in deep learning include: editing, creating and evaluating, analyzing data, testing hypotheses, problem-solving and programming, and planning and reflecting. While no task requires the application of a single thinking skill in isolation, there were isolated cases of evidence provided by student voice, that identifies the deep learning associated with specific tasks.

Editing ,creating and evaluating

One of the most common uses of ICT is word processing, for report writing, retyping essays, creating stories, and transferring documents into other applications such as PowerPoint. Word processing has a number of benefits. Maddux et al. (1997) believe word processing tasks empower students and allow them to stimulate creativity. The word processor can release the writer from the low level aspects of text production and allow the student to concentrate on the process of writing, such as drafting, editing and revising text (Underwood & Underwood, 1990).

As I'm writing it I think, it probably would be better over here and stuff like that, and so I go back to it.

The student is in a position whereby editing and evaluating their own work is important, and they are empowered to think and communicate their ideas. A further example using word processing is shown below where the student found himself

running short of time to complete the task as first intended. The student has assessed his own progress and realised the need to modify his thinking.

> *On the computer it's a lot easier as well because when I was doing it at the start, I was doing a guide to all the Egyptian Gods, but then I sort of changed my mind and thought, the deadline's Monday it will take way too long. I wouldn't be able to do that. So, I've just done it down to a profile of one God, like a big profile on him, and I wasn't actually planning that, but if I had of done it with a pen and paper…*

The student was able to use self-regulation strategies: he understood the learning task, set goals, evaluated his own progress, adapted and modified his attempts, and then revised his final product.

Analysing data

Another important thinking skill is that associated with the analysis of data. When students construct and query databases, they are building and exemplifying structural models of the content they are studying, and are comparing and contrasting relationships between information contained in their models. Databases and spreadsheets function as cognitive tools for enhancing, extending, amplifying and restructuring the way students think about the content they are studying (Jonassen, 2000). Evidence of this deep approach is seen in the example below:

> *Because, it was a lot easier to notice and stuff. When we typed up the graph it went into this graph thing (from an Excel spreadsheet), line graph, and we could actually notice it.*

The student, having received teacher instruction, has time to explore, and then pursue his/her own learning needs.

Testing hypothesis

When the ICT encourages the end-user to test hypotheses, it provides students with an opportunity to ask new questions, and think more deeply about further possibilities: it is a 'what-if' approach which is open-ended rather than the closed approach of predetermined answers. Without a computer, the exploration of alternatives is less feasible (Evans, 1986). One student tests out his own hypothesis while working with the Internet.

> *You just got to think how because if you're typing something that has ten thousand answers to your word, you've got to cut it down to a smaller thing. If you type in 'trees' heaps come up, but if you type in 'gum trees' it might come up less. Make it not as many to choose from, narrow it down.*

In the case shown the student refines the searching that tests out his thinking in his quest for more accurate information. However, other students find the open-ended nature of searching inhibits their learning.

> *Well it's a good thing (the Internet) if you know what you're looking for specifically, but if you're just hoping that something will come up, it's really hard to find stuff.*

> *Yes there's hardly anything. If you're doing a project on something a little bit different from normal, you can't learn anything from the Internet.*
>
> *I like books because the Internet's really hard to find, like the specific information you want. I go to 'search' and type in what we're looking for and sometimes it comes up if it's a subject that a lot of people look for but, if it's not, you probably won't get anything out of it.*

Students often commented on open-ended 'surfing' through the Internet, and were alert to how it impacted on their learning. For some students, they do not have the necessary skills, such as the ability to refine their search, to evaluate relevance of information, or to monitor and self-direct search strategies, and therefore the opportunity to test out any hypothetical problem-solving.

Problem-solving

Problem-solving tasks are intended to challenge and engage students to promote higher-order thinking. One of the key aspects of effective problem-solving tasks for students is to encourage metacognitive thinking strategies (Hacker, 1998). Given that every problem has three parts—givens, a goal and obstacles—metacognition will allow the student to identify the problem and work strategically (Davidson & Sternberg, 1998). A small number of students highlighted the value of ICT in assisting with their problem-solving strategies.

In the example shown, the student worked with a partner (peer learning) and was required to dissect a bull's eye so as to be able to identify and describe various parts of the eye.

> *We got a digital camera but had to share the camera around the room and ...like my partner who kind of worked with me on the project, she dissected most of the eye ball and I took most of the photos. When you've taken the photos you can look back on it and then find out what you've been working for.*

The students were able to work collaboratively and the digital camera enabled them to reflect on their learning experience. The use of ICT provided the means to reconstruct key moments through the use of visual prompts, and facilitated a problem-solving strategy for the students.

Teachers used multimedia and programming exercises as part of problem-solving. According to Papert (1980) students acquire powerful problem-solving tools by learning to program. Underwood (1990) suggests computer-based learning, such as Logo, intrinsically motivates students. Much of the early research from Papert's (1980) development of Logo (the basis for Microworlds) claims that teaching programming to students provides transferable skills (e.g. planning), seen to be integral to problem-solving (Calnin, 1998). Robotics provides similar programming experiences and is becoming a more commonly used programming tool.

> *What we (a group of students) had to do is, you get a little brick (car), they call them bricks, they've got the batteries and everything. We made it first, then you have to program it and you have to experiment, because you've got to make it go for a certain amount of seconds, and one wheel stops and the other will keep*

> *going, so it will turn around through the maze. You've got to experiment a lot of times and test it out.*

The group adopted a risk-taking approach to solving the problem. The group was able to evaluate their success by trialing the car through the maze: after each failed attempt the group would re-program the brick (car). With each programming edit there would be a retrial through the maze and the group became 'failure tolerant' in order to succeed at the given problem.

Planning and reflection

Planning and reflection are important thinking strategies that contribute to students' learning process. Planning implies a capacity to foresee a pathway to solve the problem, whereas reflection suggests an ability to modify the plan based on an evaluation of the relative success of individual stages. ICT can be used as a contemporary learning tool to support planning and reflection. The intrinsic motivational attributes of the learning situation energised the student to do more than the task required. In the evidence below, the student is highly engaged and describes planning and reflecting strategies which assist in mastering the learning task.

> *We had to write a business letter in computers and the presentation had to be good and a logo went with it, like a letterhead. I also submitted this other Excel spreadsheet that I had done earlier, but I up-dated it and made it better and made it more relevant to the thing.*

This example describes a task that was of personal interest, an intrinsic motive, and the ICT provided sufficient stimulus for the student to be cognitively enhanced, actively involved and emotionally attached to producing a quality product.

The Internet for communication

Students raised a number of issues about the integration of the Internet into the teaching-learning process that included searching strategies, currency of information, and the quality and accuracy of information. These issues were relevant to the Internet as an information resource. Students, however, also raised a number of reflections about the use of the Internet and its communication forums.

The most common use of the email was to contact friends or family. This demonstrates that the teaching-learning process has not fully incorporated email into regular classroom practice. The lack of ready access to such facilities accounts, in part, for its lack of use. A student provided the following evidence.

> *We have two sessions a week (information technology lessons) and [teacher] says…you get ten minutes at the end doing Internet time, so you're not saying, "I have to check my email, I have to do this, I have to do that." So letting us go on the Internet at the end you spend the rest of the session doing work.*

In the evidence, the email is an add-on to the prescribed lesson, awarded as a bonus for students who have completed their work. Its use is unrelated to the immediate learning goal. Further evidence highlighted that the dominant use of email was as a

communication means to contact friends and family. This was confirmed by student comments:

> *Email's good. It's fun at school. It's just a little email thing that we can send to our friends.*
>
> *Emailing's all right. I can talk to my friends there but I'd much rather see my friends than talk to them on the Internet.*
>
> *I like email because I can write to my friends at my other school.*

All three examples, whilst they encourage fun and interest, are surface learning approaches and are not connected to the learning tasks.

Another form of electronic communication includes chat rooms that enable instant messaging—synchronous communication (Maddux et al., 2001).

> *It's like you type something and they type back straight away.*

For many students, this form of communication is a preferred option to the asynchronous email forum:

> *Some kids made their own chat group [talking about a home experience] so we could talk to each other, both girls and boys.*
>
> *I usually chat to people in other classes that I know. I don't think it teaches you anything except that it's fun.*

The use of ICT for communicative purposes continues to evolve in classroom environments. One of the distinct difficulties is trying to integrate the communication tools effectively into a curriculum framework that is predominantly focused on achieving specific outcomes within subject disciplines.

Discussion

The evidence indicates that students often adopt surface approaches to fulfil work commitments without the intention of aspiring to understand and extend prior knowledge. ICT has simply made the task easier and more efficient, and allowed the final product to be presented at a higher standard. Whilst the use and familiarisation of basic technology skills can free the student to apply higher cognitive demands, the voice from students highlights an overemphasis on surface learning approaches.

The findings from this paper show that:

- The inclusion of ICT into the learning environment has created a greater focus on the collaboration and interaction between and among many students—aspects of student-centred environments. The support and guidance from the teacher remains important. The majority of students valued learning with ICT when it was relevant, gave them ownership, control and autonomy, and was conducted in environments that supported a climate of collegiality.

- Many students noted that the use of the Internet at school often inhibited their learning. Often students preferred to access the Internet at home as there were

fewer limitations and the familiarity of the home resources made it easier to use as a learning tool.

- Intrinsically motivated students were more goal-oriented toward achieving and pursuing new learning with more effort and persistence. Student activity around and in a computer environment can mask the true learning approach of the individual student. This means that the 'busyness' of a student will not automatically equate to active or deep learning. Meaningful learning was often associated with project-based learning where students were encouraged to integrate content through inquiry-based tasks.

- When the learning tasks provide little opportunity for students to explore their thinking and understanding, most students were generally passive learners. While the use of ICT has been regarded as a tool to transform thinking and learning, it can actually promote surface learning approaches. Many students often described moments where the sole intent was to reproduce or regurgitate information. The use of higher cognitive thinking was evident in tasks when ICT was purposefully integrated with subject content.

The aim of this paper was to provide insights into classroom learning supported by ICT. In implementing any strategy to improve the quality of learning there is arguably considerable benefit in studying the effect on students, and looking at the experience through their eyes. This paper has concentrated on two of Hargreaves (2004) gateways to personalising learning: student voice and the use of new technologies (ICT).

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