

Integrating online learning in NSW secondary schools: Three schools' perspectives on ICT adoption

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This report examines factors associated with integration of online learning in Sydney region high schools. Past studies have shown that schools can be identified as operating at a certain level of use - ranging from non-use, through stages such as entry, and adaptation, arriving at transformation - when a focus on technology shifts to a focus on the learner. This report highlights several factors affecting the use of online learning in Sydney high schools, including systemic factors such as institutional support, as well as micro factors such as teacher capability. After questionnaires and interviews conducted with computer coordinators during 2009, it was found that immediate school factors such as school support and focus on pedagogy were perceived as being more important than broader systemic factors.

Investigating the adoption of ICT for online learning

The "digital learner" can use ICT (information and communication technologies) both in and out of school using an "Internet learning style - interactive, search oriented, collaborative, but with individual autonomy" (Centre for Educational Research and Innovation, 2001, p. 14). The Centre for Educational Research and Innovation (CERI) has specified three rationales for schools to incorporate ICT: economic (to equip students with employable skills), social (to prepare students with digital literacy) and pedagogical (to support higher-order thinking skills).

Online education is a generic term often used interchangeably with e-learning (Rekkedal & Qvist-Eriksen, 2003) and the term goes beyond ICT to describe the learning activities undertaken with electronic technologies, usually via an Internet connection (e.g. McCombs & Vakili, 2005). For the purpose of this article, the term online learning will be used broadly and may include terms such as online learning tools, Internet tools, online tools and Web 2.0 tools, technology enhanced learning, technology mediated learning, virtual learning, as well as any learning undertaken with learning management systems, learning objects, or with ICT. As the adoption of web based instruction continues to grow steadily, teachers have become increasingly aware of possibilities for incorporating online learning into their classes (Hall, Watkins & Ercal, 2000). Many schools adopting online learning are convinced of the advantages of online learning, in spite of facing many challenges and obstacles during implementation (e.g. Samarawickrema & Stacey, 2007). This report explores institutional and micro factors that have affected integration of online learning in Sydney region Department of Education and Training (DET) high schools.

Background

Our information driven and technology based society has changed the paradigm for delivering education in the globalised marketplace (e.g. Hirtle, McGrew-Zoubie & Scofield, 2000). Governments around the world have realised that technological change is necessary for educational systems to remain relevant and competitive (DETYA, 2001; OECD, 1997; UNESCO, 2004). In Australia the Australian Government has pledged to revolutionise education by providing a computer for every upper-secondary school student and supplying 100 Mbps fibre connections to schools as part of the DER (Digital Education Revolution) (Rudd, Smith & Conroy, 2007). Yet there has been incongruity between educationalists' high perception of ICT potential and its actual use in schools (McPherson & Nunes, 2004).

Aims and rationale for the study

The purpose of this study was to determine levels of integration of online learning in high schools within the Sydney region and to identify and explore factors that may affect levels of implementation of online learning at those schools. The research questions were:

- To what extent has the integration of online learning occurred in Sydney region high schools?
- What are the factors that affect the integration of online learning?
- What can be learnt from schools that have successfully integrated online learning?

Within New South Wales there has been a sustained effort to deliver schooling materials in an online environment (NSW DET, n.d.). The public investment in the technological capability to present learning activities otherwise not offered at the school level has been seen to be a "strong political reason for moving into an online environment" (Harriman, 2002, p. 8). The NSW Department of Education and Training Corporate Plan (2008) identified the intended outcomes "enhanced state-wide access to online learning resources" and "innovation in online teaching, learning and professional development". These goals highlight the importance of investigating how successful utilisation can occur after barriers to success have been identified and overcome.

Significance of the study

This study has sought to identify and explore factors that affect schools' integration of online learning. By understanding the problems surrounding the integration of online learning there is potential for schools to adopt strategies that might address these issues. As a result of this study, systemic stakeholders may be further influenced towards assisting schools to overcome factors that hinder the integration of online learning. Potentially the results arising from this report could form the basis of a wide-scale survey that could be administered state-wide, and ascertain the extent to which integration of online learning has occurred throughout NSW and the prevalence of factors affecting integration.

Literature review

It was important to conduct a literature review to find models of schools' ICT adoption and the potential factors affecting integration of technology, in order to provide direction for the survey questions as shown in Appendix A. The Trinidad, Newhouse and Clarkson study (2005) provided a starting point, as it classified technology adoption models based on the scope of their target group. Accordingly it has been distilled that implementation of online learning can occur at a micro classroom, teacher level, or at a systemic, institutional level.

Micro models

The micro models presented in the literature refer to the extent to which an individual teacher has successfully integrated technology. Rieber and Welliver (1989) proposed that teachers must progress through certain stages of implementation - from non-use, through stages of familiarisation, utilisation, integration and reorientation, arriving at evolution - to effect change and integrate ICT successfully. The ACOT (Apple Classrooms of Tomorrow) (1995) project proposed a similar model, including the stages of entry, adoption, adaption, appropriation and invention.

Successful integration was seen to occur during the Rieber and Welliver (1989) "reorientation" phase with technology ceasing to be the main focus of integration and the focus being shifted to the learner. This concept equates with the idea of technology being a catalyst for pedagogical change (Jonassen, Davidson, Collins, Campbell & Bannan Haag, 1995) and concurs with the ACOT (1995) "appropriation" stage where there is focus on collaborative, technology based learning experiences. The ACOT "appropriation" and the Rieber and Welliver "reorientation" stages provide a crucial tipping point for teachers to invent new learning experiences and use technology to its full affordance.

The Department of Education Science & Training (DEST, 2001) specified a four-stage ICT development model with the intention of creating tailored professional development goals for teachers, as opposed to a "one size fits all" philosophy (p. 21). The DEST model comprised minimal, developmental, innovator and leader stages, the naming of the stages being obtained from an Education Qld report. Newhouse et al. (2002) proposed a multi-dimensional five-stage, four-level model of ICT integration with stages known as: inaction, investigation, application, integration and transformation. As is evident in all micro models, successful integration occurs when teachers make the transition from focussing on the technology to designing rich tasks for the learner. The critical stages detailing this shift are outlined in Figure 1.

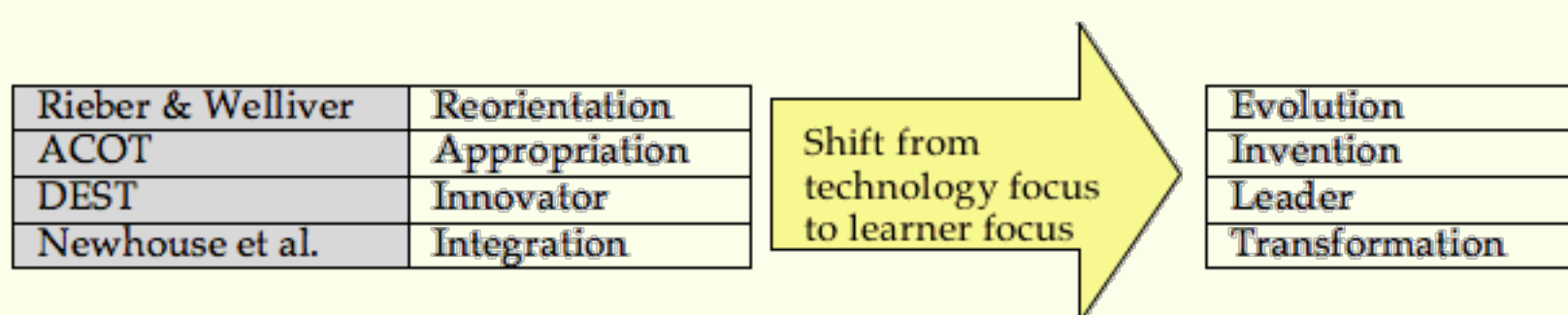


Figure 1: Summary of critical stages of micro models

Institutional models

The institutional multi-dimensional models have extra levels of complexity in order to describe a whole-school environment. The ACOT-inspired Milken model follows ACOT's pattern of technology being a catalyst for pedagogical and whole-school reform. The Milken Exchange on Education Technology (Coughlin & Lemke, 1999) transformed ACOT (1995) into a three-level continuum (entry, adaptation and transformation) for each of seven interdependent dimensions. In the transformation stage, "technology is a catalyst for significant changes in learning practice" (Coughlin & Lemke, 1999 p. 11). Downes et al. (2001) concurred that ICT is critical to the reform of pedagogical aspects, content and the organisational structure of schooling. The Ministerial Council for Education, Employment, Training and Youth Affairs (MCEETYA ICT in Schools Taskforce, 2008) used a three-stage model to show the progression from a developing school to an accomplished school and finally a leading school. In the MCEETYA model, a leading school "seamlessly integrates ICT learning, teaching and administration systems across the whole school" (MCEETYA ICT in Schools Taskforce, 2008, p. 21). Institutional models fit the pattern of the micro models, as focus shifts from technology to learner during the critical stages of implementation as shown in Figure 2.

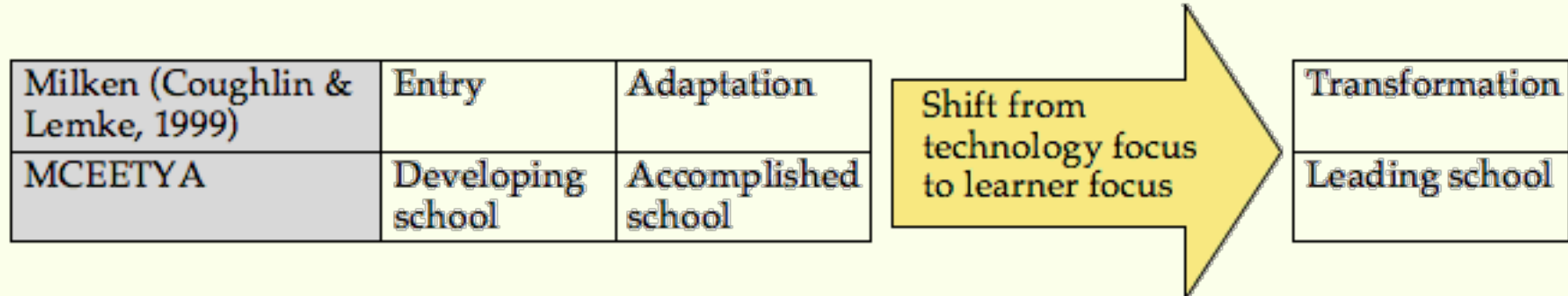


Figure 2: Summary of institutional models

Many models such as those formulated by the British Educational Communications and Technology Agency (BECTA) categorise factors as "school level" and "teacher level", or "external" and "internal" (BECTA, 2004, p. 20) or "first order" and "second order" (Ertmer, 1999), which respectively correspond to factors such as external institutional support and teachers' internal beliefs, as shown in Figure 3.

First order/ external/ systemic/ institutional level factors	Second-order/ micro/ teacher level factors
BECTA "external" (2004, p. 20) factors <ul style="list-style-type: none"> • Lack of access to resources • Lack of time • Lack of effective training • Technical problems 	BECTA "internal" (2004, p. 20) factors <ul style="list-style-type: none"> • Lack of confidence • Resistance to change and negative attitudes • No perception of benefits

Figure 3: Examples of BECTA micro and institutional factors (2004, p. 20)

Ertmer (1999) and BECTA (2004) classified teachers' internal attitudes and capabilities as "second order" factors, which are dependent upon "first order" external factors such as access to resources and training. BECTA (2004) surmised that a teacher at the classroom level requires first order factors such as technical equipment and training and support to be provided before second order attitudes and capabilities can follow. Ertmer (2005) expanded on previous research and postulated that once first order barriers are overcome, the second order factors such as teachers' internal beliefs and pedagogical understanding of ICT are the "final frontier" and a pivotal factor for teachers' integration of ICT. BECTA (2004) also highlighted that second order, micro factors reciprocally affect - to a lesser extent - first order, institutional factors (p. 20). Teacher competence (a micro factor) and school leadership (an institutional factor) were other factors found by the BECTA (2004) report to affect teachers' uptake of ICT. Serving as a preliminary model, these distilled categories, to be explained fully in the next sections - are displayed in Figure 4.

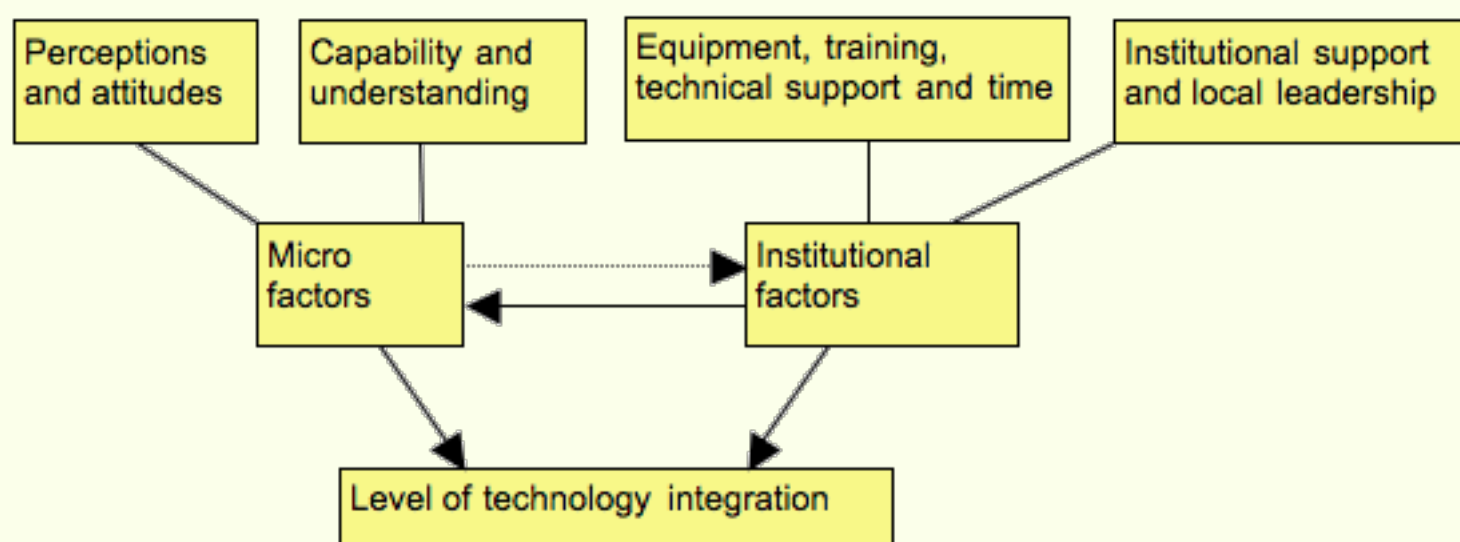


Figure 4: Factors affecting level of technology integration

As explained in the sections below, factors can be broadly categorised at the micro/teacher level as (a) Perceptions and attitudes or (b) Capability and understanding. At the systemic/institutional level, main factors can be categorised as (c) Equipment, training, technical support and time or (d) Institutional support and local leadership. It should be noted that there is usually crossover between broad categorical descriptions such as these (e.g. Berge, 1998).

(a) Perceptions and attitudes

In terms of perceptions, the technology acceptance model (TAM) posited by Davis (1989) examined the relationships among three important variables, namely perceived usefulness, ease of use, and attitudes and intentions towards adoption. Liaw, Huang and Chen (2007) built upon Liaw's (2007) proposed 3-TUM (three-tier technology use model), to show that the independent variables of perceived usefulness and perceived self-efficacy could predict instructors' behavioural intention to use e-learning. In the Liaw et al. (2007) study, perceived e-learning satisfaction was found to be a key factor affecting instructors' cognitive perceptions, such as perceived self efficacy and perceived usefulness of e-learning.

Attitudinally speaking, teachers who harbour a negative attitude towards utilising online learning are unlikely to be successful at implementing online learning. Samarawickrema & Stacey (2007) found that teachers "who had a more open attitude to online technologies" (p. 16) were convinced of its value before implementation. Teacher confidence has been identified as being central to

ICT integration (e.g. Jamieson-Proctor, Burnett, Finger, & Watson, 2006) and many teachers have expressed a lack of confidence, a "fear of admitting to their pupils that they had limited knowledge" (BECTA, 2004, p. 20). In terms of beliefs, Ertmer (2005) found a direct connection between teachers' pedagogical beliefs and technology usage, since technology skills are "unlikely to be used unless they fit with teachers' existing pedagogical beliefs" (Ertmer, 2005, p. 37). Ertmer demonstrated how teachers' pedagogical beliefs have an overarching effect on their perceptions of, and their attitudes towards technology adoption. According to Ertmer, all teachers filter information about teaching innovations through their existing beliefs, which can limit their potential for understanding.

(b) Capability and understanding

According to Cuban (2001), many teachers don't understand how to incorporate technology into their teaching. Condie & Livingstone (2007) cited lack of understanding about ICT learning strategies as a major issue that affected successful incorporation of online learning. According to Oliver & Herrington (2003) teachers need to have the capability to select and develop appropriate content for flexible, technology based learning. On the subject of affordances, research conducted by Fishman, Soloway, Krajcik, Marx & Blumenfeld (2001) resulted in the recommendation that planning for technology integration should start with questions about how teachers want to teach with the technology. Clark (1994) advocated that any technology-driven implementation in a learning environment cannot be successful without matching useability and utility to the learning objectives. Bower (2008) has postulated that learning designers and teachers should be supported in their quest to match learning tasks to learning technology, thereby improving their understanding as well as their effective use of technology.

An important framework for teachers' knowledge was formulated by Mishra & Kohler (2006), who put forth that teachers' knowledge can involve three components: content knowledge, pedagogical knowledge and technology knowledge. Drawing on Shulman's (1986) framework of pedagogical content knowledge (PCK), which is the intersecting knowledge between pedagogy and content, Mishra & Koehler postulated that teachers cannot view technology knowledge (TK) as distinct from pedagogy knowledge (PK) and content knowledge (CK), indeed there must be knowledge that teachers must possess in the overlapping regions called technological pedagogical knowledge (TPK), technological content knowledge (TCK) and ultimately, technological pedagogical content knowledge (TPACK) as shown below in Figure 5. Their study showed that participants moved away from considering technology, pedagogy, and content as independent constructs.

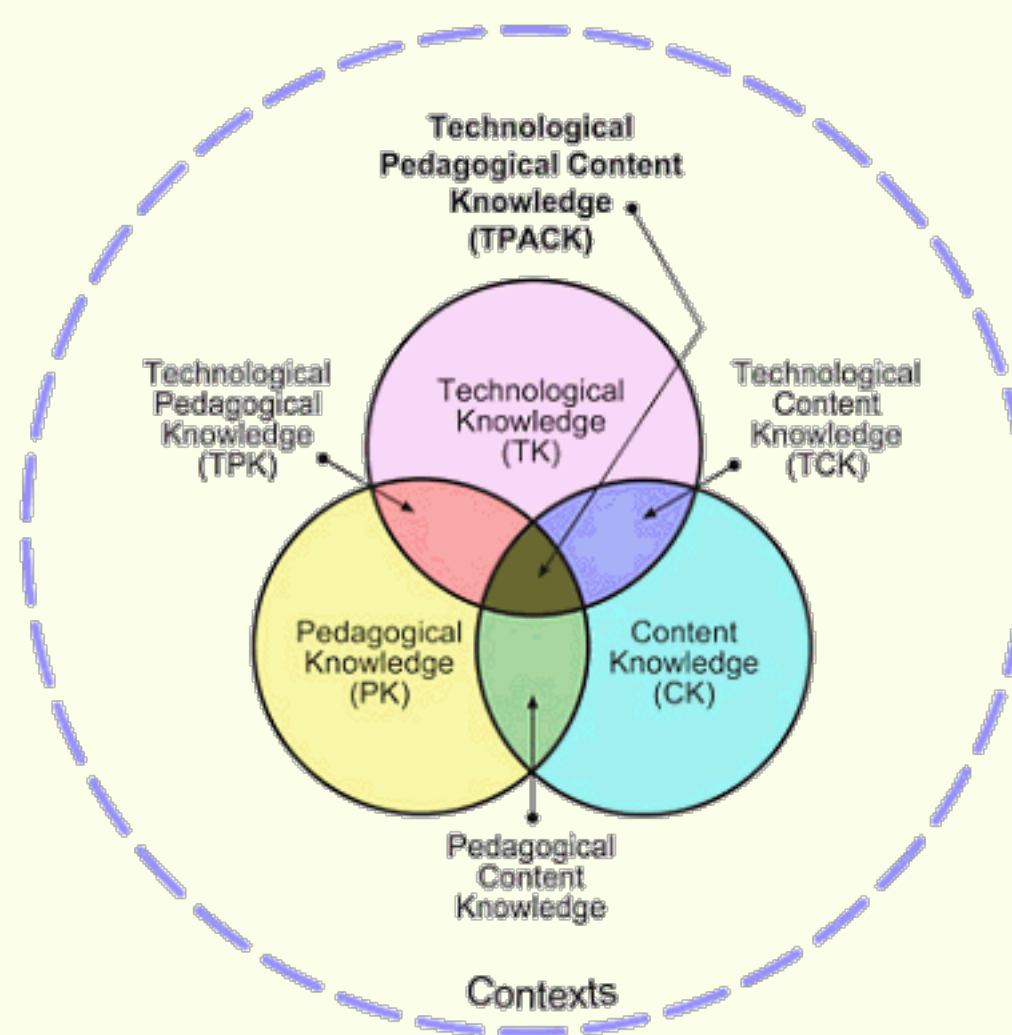


Figure 5: TPACK - the intersection between TCK, PCK and TPK (Mishra & Koehler, 2010)

Teachers' knowledge is obviously linked to training and professional development. ACOT (1995) proposed that teacher understanding is not possible without proper training and professional development. In the UK Universities and Colleges Information Systems Association UCISA survey, Browne, Hewitt and Walker (2008) put forth that capability cannot be realised unless teachers have access to resources, training and technical support - as detailed in the next section.

(c) Equipment, training, technical support and time

Provision of ICT and technical support are first order factors affecting technology integration. Tennant, Birch, Lismann and Plones (2004) cited reliable technical support as a major factor affecting a successful pilot of online learning. A New Zealand Education Review Office study stated that technical support was a significant factor affecting schools' successful use of their e-learning packages (Education Review Office, 2005). Technical problems were nominated as a barrier to successful ICT use in 13% of the

total responses for the BECTA (2004) survey. The New Zealand Education Review Office (2005) found that many schools had budget problems involving "funding, maintaining, and ensuring sustainability of ICT equipment" (p. 12) for the purpose of implementing online learning. The researchers who conducted the UCISA survey (Browne, et al., 2008) found that over the course of their longitudinal research "central funding for service support and project funding assumed an even greater significance as a means of enabling development [of technology enhanced learning]" (p. 2). The UCISA survey discovered that a trend towards the adoption of Moodle (an open source virtual learning environment) had occurred at a departmental/school level because it was an attractive and cost effective means for schools and institutions to adopt online learning.

On the subject of training, Downes et al. (2001) recommended that government, teacher education and professional bodies work together to improve "the knowledge and skills of teacher educators, many of whom remain unconvinced of the importance of the integration of ICT in their own teaching and learning" (Ertmer, 2005, p. 80). So & Kim (2009) suggested that pre-service teachers should be targeted to undertake learning experiences formulated to develop their understanding of pedagogical aspects of technology integration. Mishra & Koehler (2006) agreed that the development of Technological Pedagogical Content Knowledge should be a vital goal of any teacher education course. Further, the authors of the Downes et al. study (2005) recommended that there should be systemic continuing professional development programs for all practising teachers. Way & Webb (2007) identified professional development as a critical factor in the successful integration of ICT, on the proviso that it must align with the school's particular situation and needs. Hegarty et al. (2005) surmised that early adopters - (the innovators who are willing to take risks) as opposed to the late adopters (who prefer gradual or no change) - have different professional development needs, which is consistent with DEST (2001) and Weaver (2006). The study from Hegarty et al. (2005) also established that differentiated and timely staff development was a factor that contributed to the successful adoption of online learning, which means that more time needs to be allocated to these activities.

Lack of time was nominated by teachers as a hindrance to ICT uptake in 16% of total responses in the BECTA (2004) survey. In the UCISA (Browne, et al., 2008) survey "lack of time was identified as the main barrier to further developments to promote TEL [technology enhanced learning]" (p. 2). According to Downes et al. (2001), it is not just time that teachers need in order to "understand new concepts, learn new skills, develop new attitudes. More crucial still is the recognition that the provision of time must accompany a major redefinition of the nature of teachers' work" (p. 75), thus transforming the school and the entire organisational structures, as detailed in the next section.

(d) Institutional support and local leadership

McPherson and Nunes (2004) named an institution's organisational context, encompassing its entire educational setting and pedagogic model, as the "most critical" factor in determining the success of online learning implementation (p. 24). They argued that an organisational context imposes constraints on its online course implementation, in an ongoing cycle of action planning, action taking and action evaluation. Entire school community involvement and commitment from the executive team and all teaching staff, including beginning teachers (Gao, Wong, Choy & Wu, 2010) is a main factor of successful technology integration (Bernauer, 1996). This was confirmed by Hayes and Harriman (2001), who concluded that the most important factor influencing the success of technology integration "was the active involvement and support of the principal" (p. 5).

In terms of leadership, Samarawickrema and Stacey (2007) found that only people in management or leadership positions "can facilitate a climate conducive to innovation adoption" in the institutional context (p. 330). According to ACOT (1990), when teachers are led by administrators "who actively support fundamental change, there is far greater opportunity for successful growth of new beliefs and practices" (p. 9). Moyle (2006) offered that "a whole school culture of learning" (p.98) should permeate any ICT implementation effort. The presence of committed local champions was seen to be a major factor driving online learning in the 2008 UCISA survey formulated by Browne et al. (2008).

A collegial culture where teachers exchange ICT knowledge and experiences was the strongest factor affecting ICT integration levels in schools participating in a study conducted by Baskin & Williams (2006). Chou (2005) concurred that institutional and technical factors are critical to teachers' attitudes towards and understanding of technology, but found that knowledge sharing forms an important part of an institution's culture. Park & Ertmer (2008) found that vision sharing was the most important factor affecting adoption of its technology-based PBL (problem-based learning) initiative because many stakeholders seemed confused about what the school was attempting to achieve. This is in agreement with Divaharan & Lim (2010) who found that there must be a curriculum focussed, overarching ICT goal for schools to be successful learning institutions.

Some of these institutional and micro factors were utilised in the questionnaire of the ensuing research design as discussed in the next section. As is evident in the developed questionnaire as shown in Appendix A, there was more emphasis on school-level factors than micro factors, because this research project relates mainly to the whole-school situation. The factor "perception of effectiveness" - encompassing attitudes towards usefulness and efficacy (e.g. Davis, 1989) - was chosen to represent the micro category (a) *Perceptions and attitudes*. "Pedagogical issues", as noted in the literature to be a pivotal micro factor for realising technological capability (e.g. ACOT, 1995), was chosen to represent (b) *Capability and understanding*. To study the pragmatics of implementing online learning in a school environment, seven of the fourteen questionnaire factors, namely "training", "resources", "quality of online learning tools", "budget", "licensing", "technical support" and "time" - were chosen to represent the institutional category (c) *Equipment, training, technical support and time*. The systemic factors of "direction from the Department of Education", "assistance from the Department of Education" and "policy from the Department of Education" were included in the questionnaire to ascertain perceived level of systemic support by examining (d) *Institutional support and local leadership*. School support, being dependent upon of culture of knowledge sharing (e.g. Chou, 2005) was included to rate local institutional culture.

The importance placed on committed innovators (e.g. Browne, et al., 2008) was included to measure a level of local leaders' commitment to innovation.

Method

This research project comprised two stages. In the first, a diagnostic questionnaire (Appendix A), was used to determine the extent to which schools have implemented online learning in high schools in the Sydney region. Schools were classified by respondents as being developing, accomplished or leading schools. An open ended response question was included in the questionnaire to provide insight into the computer coordinators' quantitative responses. The second stage of the study involved interviewing a key stakeholder from each type of school fitting stages from the MCEETYA model (MCEETYA ICT in Schools Taskforce, 2008), in order to delve into more detail and gain a deeper understanding of the importance of factors affecting schools' levels of integration.

Participants and target audience

All 54 Department of Education secondary schools in the NSW Sydney region as listed on the Sydney Region Department of Education website formed the questionnaire population. An email was sent to the computer coordinator at each school to invite them to participate in the survey on a purely voluntary basis. The computer coordinators at DET schools are the main decision makers with regards to management of technology in their school and they were seen to be the most useful participants in being able shed light on and provide a snapshot of, their school's use of technology. For this reason, principals, teachers or students were not approached, since they may not have been familiar with detailed implementation aspects of online learning occurring at their schools.

From 26 questionnaire responses, three schools were chosen for the interview stage - to represent each of the developing, accomplished and leading school categories. The three schools were chosen as a convenience sample based on their willingness to be interviewed within a certain time period and logistical proximity. The interview questions are shown in Appendix B. All participants were assured that neither their school nor their personal identity would be disclosed in the final report. It was anticipated that up to an hour would be spent interviewing each computer coordinator at the schools identified as being developing, accomplished and leading schools. In qualitative studies, it is sensible for samples to be purposive, rather than random (Kuzel, 1992), which is why certain schools were targeted depending on the extent to which online learning had been implemented. While the interpretations are based on a small sample size, it was hoped that differences between developing, accomplished and leading schools would become obvious.

Data collection and analysis procedures

Quantitative questionnaire data

The questionnaire (as shown in Appendix A) was set up online and available to computer coordinators over a one-month period. It was assumed that computer coordinators would have the most knowledge about online learning occurring in their school since they were the main decision makers in this area and that an email and online questionnaire method would be the most convenient and familiar way for the computer coordinators to access the questionnaire. The respondents were also asked if they would be willing to participate in an interview.

Computer coordinators were asked to rate the importance of various factors affecting their school's adoption of online learning. A scale (1 = not at all important, 2 = not very important, 3 = fairly important, 4 = very important) was used to register the perceived importance of each factor. Preliminary analysis of computer coordinators' quantitative responses regarding factors affecting implementation of online learning resulted in calculations of means of ratings and non-parametric tests that guided the focus of interview questions. Stochastic techniques, such as homogeneity tests and factor analyses, were also explored.

Qualitative questionnaire data and interview data

Qualitative data were collected through interviews as well as through answers to the open ended questionnaire questions, which were recorded and stored in a database. The qualitative data were recorded, transcribed and de-identified prior to coding by the researcher, who was acting in an observer-as-participant role. The transcribed interviews and questionnaire data were coded line by line using NVivo8 as labels and themes were generated to build an explanation so that the factors affecting the implementation of online learning became evident.

Findings

Quantitative questionnaire data

Of the 26 responses, four computer coordinators self-classified their schools as having a successful, wide scale implementation, eight classified their schools as having a successful, small scale implementation, 10 identified their schools as progressing towards a small scale implementation and four computer coordinators had prioritised online learning for future implementation. All computer coordinators classified online learning as either an effective or very effective means in assisting achievement of educational outcomes. It should be noted that perusal of evidence of schools' actual improved educational outcomes through the integration of online learning was beyond the scope of this study.

Ratings of questionnaire factors

A one way ANOVA of the responses for the 14 factors indicated a significant difference between the mean scores for the factors, $F(13, 350) = 8.428, p < 0.001$. The means of respondent ratings for each of the fourteen questionnaire factors is shown in Table 1.

Table 1: Means of respondent ratings of questionnaire factors

Factor	Mean	Standard deviation
School support	3.88	0.33
Time	3.84	0.37
Committed innovators	3.73	0.45
Training	3.73	0.53
Quality of online learning tools	3.69	0.47
Technical support	3.62	0.33
Resources	3.58	0.76
Perception of effectiveness of online learning tools	3.46	0.58
Pedagogical issues	3.31	0.68
Budget	3.23	0.67
Assistance from the Department of Education	3.19	0.90
Licensing	2.88	0.86
Policy from the Department of Education	2.84	0.88
Direction from the Department of Education	2.77	0.76

Factor analysis and regression tests indicated that there was no significant difference between the levels of implementation for any of the factors (which may have been due to the small sample size), so an attempt was made to identify homogenous subsets; however these subset results were discarded due to the limitations of the sample size.

Qualitative questionnaire data

Schools with prioritised future implementation

Computer coordinators at schools in this category said that integration of online learning was seen as an additional task on top of an already full curriculum. Lack of time was the main reason offered for not implementing online learning at these schools: "Schools are very busy places and staff members are committed to many different issues and activities."

Developing schools progressing towards a small-scale implementation

Echoing the sentiments from the previous category, many computer coordinators in this category identified lack of time as an issue. One respondent in this category said that "teachers are a bit overwhelmed with such fast changes". According to another respondent at a developing school, teachers "need time to prepare and adapt their existing resources and locate and refine other resources to meet the individual needs of their students." Another computer coordinator at a school in this category commented, "Some staff members are very interested but lack the time and resources to develop their own skills or to pass them on to other teachers." One computer coordinator who had identified their school as progressing towards a small scale implementation was particularly alarmed about teachers' increased workload: "Asking them to take on board yet another task in an already overcrowded curriculum and extremely busy work day is pushing many teachers to the limit and in some cases beyond" - which indicates that technology integration was perceived to be an optional add-on.

Two computer coordinators in this category were concerned about the pedagogical issues associated with integrating ICT. According to one of them, teachers need to learn "how to use the application to focus students on learning and encourage them to search out new and interesting solutions to open ended questions." The other concurred that teachers needed to be convinced why online learning is useful, particularly because they don't understand why they should change and "don't want to know how to do anything differently when they are successful in the way they currently teach".

Two schools in this category complained about infrastructure: one said that it was near impossible for teachers to book a computer room and another said that their school did not have an efficient and reliable network. Another theme in this category was the need for training and support, targeting enthusiastic early adopters. One school in this category had successfully trialled training "in small teacher groups [with] two or three staff from same faculty" to drive faculty adoption of online learning. One computer coordinator at a developing school mentioned that they would like to have access to examples of best practice. Another computer

coordinator at a developing school reinforced this sentiment, asking to be led by leading schools that have successfully integrated online learning. Overall, the computer coordinators in this category were more negative than positive attitudinally speaking, and did not feel that teachers at their schools possessed a positive attitude towards online learning: "Many staff members feel that they are being forced into using these tools" and are "somewhat put off by what's available and how they'd use it."

Accomplished schools with a small-scale implementation

Schools in this category seemed slightly more positive about integrating ICT. As one respondent in this category expressed, "There is a growing interest and understanding of the technology now available and many teachers can see the potential." Computer coordinators at schools with a small scale implementation seemed to have shifted their attention to the learning that can occur with ICT integration. One of these computer coordinators said that "the staff is very progressive with respect to technology and can see the benefits that the placement of online learning materials can provide for teachers and students." Another said there was pressure from students and their families: "Students have extremely high expectations of teachers and technology. This, more than anything, has been the primary driver in the take up of online learning."

Many schools in this category realised that there were pragmatic advantages afforded by online learning: "having access to online learning materials and other curriculum resources provides the means for students to catch up. Online materials also provide a mechanism for incremental improvement of the teaching-learning program." One computer coordinator in this category was concerned that policy from the Department of Education inhibited progress: "DET policy of blocking certain Web 2.0 applications such as blog sites has hindered uptake of online learning."

Leading schools with a wide-scale implementation

Schools in this category understood the transformative effect of technology on pedagogy as focus shifted to the learning process: "Teachers need to be convinced that the technological route to learning is the most effective pedagogically. Many don't want technology to be an imposed layer over their teaching."

One leading school had an effective plan for the development of online materials: "The curriculum is crowded. Technology must target the most suitable areas in the KLAs [key learning areas]." Another computer coordinator at a leading school had a coherent training strategy and found that offering a "train the trainer" course to interested staff meant that enthusiastic and confident trainers were unleashed on the rest of the staff and ensured that they had "a smooth transition into the online world."

Interview data

The developing school progressing towards small scale implementation

Past network and infrastructure problems had caused some teachers at this school to become disillusioned about using technology in their classes. "The teachers obviously got upset, got distressed. They didn't want to have anything to do with anything to do with computers because the things didn't work."

The main factor seen to be inhibiting adoption was fearfulness.

They're scared, they're frightened. There's nothing more frightening for an established career teacher who has gone through their career and knows exactly what they're doing there, extremely well-organised, incredibly competent within the classroom environment - and asking them to re-organise and change their learning management, their pedagogy.

The computer coordinator, who had helped 50 out of 90 staff log onto the school online learning site, had a concrete goal "to get the whole school online. I want to get the rest of the staff online". A mentor training model was signified as the best way to achieve this: "I've trained three other members of staff as early adopters. And then I've got a member from every faculty to be nominated as an early adopter. So they'll become part of 'train the teacher' type training." The school was developing a collegial culture and knowledge sharing was beginning to become entrenched: "Some teachers will give anything to anyone 'Here's my worksheets, take them and you can use it, I don't care'." The overwhelming sentiment from this computer coordinator was that being an online learning system administrator was "a full time job". He said he spent at least three hours a day, in addition to teaching duties, performing administrative tasks for the school's online learning site. He was lucky enough that the principal was extremely supportive and had no problems with budgeting for training.

In this school online learning was seen as extra work for the teachers who were not confident with using technology, which indicates that it was seen as an optional add-on, instead of being integrated fully into the curriculum. The computer coordinator understood the importance of changing pedagogy for the Net Generation: "we've got to get with it - Gen Y, Gen Z learners - they're all slightly different and expect different things."

The accomplished school with small-scale implementation

The computer coordinator here said that his high school had always had a very robust computer network, which meant that

teachers possessed a fairly positive attitude towards technology. He said that there was little resistance to using ICT but overall he had a realistic idea of whole school online learning adoption: "It's not going to happen overnight". There was a sense that technology use was seen as necessary to perform administrative tasks. The computer coordinator told a story of a recently retired teacher, who had initially had problems using technology ("She wasn't resistant, she was really just fearful") but with effort, had learnt to use the school's computerised packages and ended up with the confidence to show other teachers how to use them.

There was a palpable sense of skill sharing at this school, which had an open plan whole-staffroom and meant that a culture of sharing was second nature because colleagues were always available to help others and willing to help solve problems. This school originally became aware of online learning management systems after a visiting teacher conducted some in house training. The principal at this school was also very positive about integrating technology and had been seconded to write Department of Education technology policy. There was a head teacher of teaching and learning whose job it was to help teachers create learning objects for the interactive whiteboards. The head teacher of teaching and learning was also allocated relief time to help teachers digitise their resources.

The computer coordinator discussed the lack of time available for experimenting with technology: "Terms one, two and three are just flat-chat and it's only in term four when you get the time to experiment." He mentioned the DER (digital education revolution) project as being an impetus for reviving the school's online learning management site, which had laid idle for a couple of years until late 2009, when he and another teacher conducted a training session. The computer coordinator had understood the convenience afforded by providing materials to students online but realised that online learning had not reached its potential uptake: "You run the risk of people being disappointed. Kids go onto the Moodle to get a resource and it's not there."

The school's principal had projected the idea that pedagogy must be adapted to suit their senior students. The computer coordinator reinforced this concept when he mentioned the way that learning materials must be delivered to appeal to the proclivities of the Net Generation. This senior high school had a goal of providing online materials for every subject within two years, with the first influx of the digital education revolution students.

The leading school with wide scale implementation

The computer coordinator was the epitome of a local committed champion: "Somebody has to do that; it's not going to happen otherwise." This computer coordinator found a lot of professional satisfaction in administering the school's online learning management site. She was in the main self taught, even spending time on her weekends developing online course materials. Interestingly at this school, considered to have a high level of implementation because every subject in the school had its own online courses, the computer coordinator took an exceedingly active role in helping other faculties put up their materials, in at least one case hyperlinking materials for one faculty instead of helping the faculty perform the task themselves "which I know is ridiculous. They should do it themselves, but that wasn't going to happen."

The digital education revolution, including the provision of laptops to year nine students in 2009, was highlighted as an impetus for adopting online learning as teachers were "really forced into ... other options of delivering their materials." This computer coordinator had a strong view about the way technology should be utilised in the curriculum for the Net Generation: "I also think that we're preparing the kids for tertiary education... it doesn't matter whether they're going to go to university or TAFE or into an organisation with a job, they're going to do online learning."

Embarking on a journey of developing an online learning site was seen to be fraught with equity issues for students of teachers who did not provide access to materials: "it's important for their students to have access to the files that they need". This computer coordinator also identified issues associated with successful integration (such as netiquette and cyber bullying) and mentioned that increased reliance on digital learning meant that students must use the online learning tools sensibly and responsibly.

The computer coordinator maintained that there were no whole school goals for online learning; instead there were personalised plans for helping teachers in each faculty: "different things work for different people." She said that there were some teachers who avoided using technology to its full advantage but did not force them: "That's their choice in the classroom, whether they use it or not." The principal was supportive, but it was chiefly the computer coordinator's initiative. Some head teachers had already joined the revolution and other teachers around the school were quite proactive in creating online learning materials, but the computer coordinator mentioned there was always more training she could conduct to help improve adoption; yet the school hadn't had the money to provide release for teachers' professional development activities such as these. This school, like the developing and accomplished schools, had links to outside organisations, which helped inspire them to drive online learning in their own schools.

Discussion

The following section discusses how the findings compare with prior research undertaken in this area, with regards to the micro and institutional factors affecting adoption of online learning. The developing school is compared with the accomplished and leading schools to find out what can be learnt from the schools with more successful implementations.

Perceptions and attitudes

Questionnaire data indicated that all of the computer coordinators harboured the perception that the adoption of online learning has the potential to positively affect educational outcomes in their schools. Questionnaire comments indicated that decision makers'

positive attitudes seem to correlate with a higher level of integration at their school.

The interviewed schools seem to have an understanding of the need to provide electronic material for the "Net Generation". Across all three interviewed situations, teachers' willingness to experiment was one factor mentioned as being particularly important for schools that successfully adopt online learning. The three interviewed computer coordinators also mentioned that some teachers avoided online learning because of fearfulness. This correlates to the literature relating to teachers' positive attitudes and confidence affecting technology uptake (e.g. BECTA, 2004). Developing schools reported that teachers at their schools possessed attitudes that were more generally negative than positive; while the accomplished and leading schools reported teachers to be more positive towards online learning. Therefore teachers' attitudes may be a key factor in successfully integrating ICT and would be a topic worthy of further study.

Capability and understanding

In questionnaire comments, greater emphasis was placed on changing pedagogy in the cases of the accomplished and leading schools, which is consistent with the literature (Coughlin & Lemke, 1999) relating to technology use, pivotal pedagogical aspects and consequent school reform. At the accomplished and leading schools there was a high level of understanding about the transformative effect of technology adoption being an impetus for pedagogical change (c.f. Jonassen, et al., 1995).

Equipment, training, technical support and time

Constraints on online learning administrators included lack of release time to set up course materials. All three interviewed computer coordinators were seen to be doing a lot of the work in driving the initiative, which meant that "time" was perceived to be a major issue - consistent with the quantitative results of this project as well as the reviewed literature (e.g. Browne, et al., 2008). The interviews found that lack of access to equipment was seen to be more of an issue at the developing school than at the accomplished or leading schools.

Institutional support and local leadership

The presence of enthusiastic early adopters and local champions is mentioned in the questionnaire remarks of the developing, accomplished and leading schools. There was more allusion to an established collegial culture by interviewed computer coordinators at the accomplished and leading schools than at the developing school. According to the quantitative questionnaire results, immediate school-based factors "at the coalface", such as school support and committed innovators, were rated as important factors affecting online learning integration. External factors, including policy, assistance and direction from the Department of Education, were not seen to be driving online learning in high schools.

From the quantitative questionnaire results it could be interpreted that respondents thought that immediate and direct factors played a larger influence in the effectiveness of online learning tool integration than contextual and external factors. Local leadership, including the level of school support and commitment to innovation, was seen to be more important than broader systemic level strategies.

In the three interviewed schools, the computer coordinator was the local champion, and the committed innovator. All three schools had a supportive principal, which is consistent with other research (e.g. Hayes & Harriman, 2001). Whole school involvement is a very important factor for schools' progression to becoming a leading school where "new learning opportunities are possible through the creative application of technology to the entire school community" (Coughlin & Lemke, 1999, p. 11). Collegial culture is another factor that may be worthy of further research, in addition to teachers' attitudes as an important factor affecting uptake of online learning,

Conclusion

A range of technology adoption models have been identified in the literature, including micro models with minimal, developmental, innovator and leader stages (DEST, 2001) and institutional models with developing, accomplished and leading stages (MCEETYA ICT in Schools Taskforce, 2008). Research in this field has indicated a variety of factors that influence technology adoption, including micro level factors such as teacher attitudes, and institutional level factors such as school support.

Computer coordinators at Sydney region high schools in 2009 identified their schools to be at a range of levels of adopting online learning: highly prioritised for future adoption, progressing towards small scale adoption, successful small scale adoption, or successful wide scale adoption. From the questionnaire and interview data, it can be seen that immediate and direct factors were perceived to be of greater influence upon successful online learning adoption than broader systemic factors. This provides impetus for schools to develop their technology leadership, develop strategies to overcome attitudinal barriers and garner school support for online learning. Aligning with the NSW Department of Education and Training Corporate Plan (2008), there should be renewed efforts to improve innovation in online learning, especially as the digital education revolution gains momentum.

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Appendix A: Survey questions

1. How would you describe the level of implementation of online learning tools at your school? (Successful wide-scale implementation, Successful small-scale implementation, Progressing towards small-scale implementation, Highly prioritised for future implementation, Non-existent, Other - please specify)
2. How would you describe the overall level of support amongst your school community for the implementation of online learning tools? (Very positive, Somewhat positive, Neutral, Somewhat negative, Very negative)
3. How effective do you personally perceive online learning tools to be at improving educational outcomes? (Very effective, Somewhat effective, Neither effective nor ineffective, Somewhat ineffective, Very ineffective)
4. Rate the significance of these factors in affecting your school's adoption of online learning tools.

	Very important	Fairly important	Not very important	Not at all important
Technical support				
Time				
Direction from DET				
Assistance from DET				
Licensing				

Policy from DET				
School support				
Resources				
Training				
Perception of effectiveness of online learning tools				
Quality of online learning tools				
Pedagogical issues				
Budget				
Committed innovators				
Other factor/s (please specify significance)				

5. Please expand on the responses you gave in the previous question by explaining why certain factors have affected your school's implementation of online learning tools.
6. Would you like to be emailed the research report arising from this study? (No, Yes)
7. Would you be willing to be interviewed about your school's implementation of online learning tools? (No, Yes)
8. If you have answered yes in either question 6 or 7, please provide your contact details.
Name:
School:
Email Address:
9. Please use this space to provide any further comments about factors that have affected your school's adoption of online learning tools.

Appendix B: Interview questions

1. Describe the process from initial adoption through implementation to institutionalisation of online learning tools at your school.
2. What were the initial motivations for implementation? (E.g. need, career incentives, resource availability, constructivism, advocacy by external sources etc.)
3. Describe any support that your school has received from DET to implement online learning tools.
4. How have teaching beliefs and teaching approaches changed since implementation?
5. How has the use of teaching materials changed since implementation?
6. Explain any policies that your school has developed or used, to guide the implementation of online learning tools.
7. Describe any technical support that your school has received to implement online learning.
8. Describe the training that you personally have received to implement online learning.
9. Describe any training that, to your knowledge, has been provided to members of the school community regarding online learning.
10. What is your opinion about the educational merits of online learning tools?
11. How would you describe the level of support for online learning tools amongst:
 1. Teachers
 2. Students
 3. Parents
 4. Executive members
12. What level of maintenance do you personally provide for the online learning tools?
13. Describe the types of online learning activities utilised in your learning management system.
14. How did your school decide on the learning management system used?
15. What parts have been revised since your initial implementation?
16. What changes are you considering making in future?
17. How often is the system reviewed for technological currency and cost-effectiveness?
18. How is the system evaluated in terms of learning effectiveness?
19. Describe how budgetary requirements affected implementation.
20. Explain the technical requirements needed to implement online learning tools at your school.

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