

# One-to-one computing: literature review



# Draft

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Version 3.3, March 2009

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## INTRODUCTION

*The focus will never be on the technology. Rather, it's the pedagogy that counts. It's worth keeping in mind that laptops are only a tool. They're at our disposal to make learning easier, and more enjoyable and meaningful for children. (Holmes, 2008)*

One-to-one laptop programs are expanding rapidly across the world with large-scale initiatives such as Microsoft's *Anytime anywhere learning* and the *One laptop per child* program. Across the United States there are large programs in Maine, Henrico County Virginia, Louisiana and other pilot programs in Texas, Florida, New Hampshire and California.

Laptop programs are diverse, taking on a variety of forms with school-leased laptops, parent-purchased laptops or the system-wide provision of mobile laptop carts or student laptops. These programs have a range of goals such as:

- improving student learning and academic achievement
- facilitating a differentiated, problem-based learning environment demanding higher-order thinking skills
- fostering more collaborative, inquiry-based learning
- providing timely, more equitable access to a broader range of digital educational resources
- enabling the development of computer literacy skills, especially where students are reluctant to use technology or do not have immediate access to a computer
- preparing students to better compete in technology-rich workplaces
- increasing economic competitiveness of local regions in the global marketplace.

Whilst laptop programs have varied approaches, they are most effective when:

- each student has individual access to his or her own computer (usually called a one-to-one program)
- every computer is loaded with software such as word processing, spreadsheets and multimedia creation tools
- there is access to the internet enabled through a wireless network
- every computer is fitted with a battery which has a long life.

*It is really not about the laptops. It's about what the 1:1 laptops enable in terms of new ways of teaching and learning. (Dunleavy, Dextert & Heinecket, 2007)*

Traditionally, restricted access to computers based in laboratories is the most common obstacle teachers cite for making limited use of technology in teaching and learning. If computers are in laboratories, timetabling difficulties can markedly reduce opportunities for technology-enhanced learning. For computers to make a significant difference and become integral to the learning, students need unfettered access.

*I don't have to 'waste' time trying to schedule the computer lab. We can make much better use of the 'teachable moment with immediate access to computing, researching, brainstorming, etc. technologies. Students have more time for learning because they don't have to wait in line for a learning tool. Maine teacher*

Increasingly affordable, portable and powerful laptops with wireless connectivity are enabling universal access to become a reality.

*One-to-one laptop programs arguably offer the greatest potential of educational technologies to date in that they place the most power and versatility in students' hands, while wireless network connections open vast new vistas for communication and collaboration. (Grimes & Warschauer, 2008)*

Personal student laptops which offer mobility and accessibility at school and beyond can empower students to take control of their own learning. This is an unprecedented opportunity for transformation of teaching and learning.

All students must have access to modern learning tools and challenging curriculum to move towards achievement of 21st century skills. One-to-one computing can provide a real-world, relevant education that can improve thinking and problem-solving skills and information and communication technology (ICT) skills meeting community needs and students' expectations.

Whilst there are issues which need to be faced, these can be acknowledged and addressed without deterring or overly distracting us from our focus which should remain firmly on the educational opportunities and benefits for our students.

*This paper is intended to assist all those involved in the implementation of laptops for learning in NSW public schools. It brings together key findings from research and overseas experiences in relation to:*

- The one-to-one laptop environment – *What does it look like?*
- Effects on student learning – *How can laptops support student learning?*
- Classroom uses of laptops – *What do students actually do with laptops?*
- Factors influencing successful implementation – *What do we need to do?*
- Support for teachers – *What does effective teacher support comprise?*

## THE ONE-TO-ONE LAPTOP ENVIRONMENT

A comparison of traditional and technology-rich classroom environments suggest that pedagogical approaches are different.

In a traditional classroom: teachers tend to spend more time giving instruction, leading discussions, asking and answering questions and managing the classroom; students are largely involved in asking and answering questions, working individually and as a whole group.

In a technology-rich environment: teachers are mostly engaged in demonstration, directing activities and talking to and listening to students; students are often working on projects, working collaboratively in small groups and communicating with other students. A technology-rich classroom environment provides opportunities for a more project-based and small group orientated learning environment.

*Today's students expect their school assignments to be relevant, challenging, and related to the real-world. They value problem solving, communication and the chance to collaborate as adults do in the real world. (Barrios, 2004)*

What is unique about a one-to-one computing environment? Swan, Kratcoski, Mazzer & Schenker, (2005) report that teachers believe a learning environment where students use laptops facilitates more authentic, collaborative and project-based learning where students are more engaged and motivated to learn, producing higher-quality work.

In a laptop classroom:

- there tends to be more project-based learning and independent inquiry/research
- there may be more opportunities for cooperative learning than in other classrooms
- the teacher is more likely to act as coach/facilitator
- students can access a broader range of resources
- technology is incorporated to a much greater degree than other classrooms.

*Teachers must create instructional environments in which students use higher-order cognitive skills to construct meaning or knowledge, engage in disciplined enquiry, and work on products that have value beyond school. (Barrios, 2004)*

As a consequence of the appropriate use of laptops for learning, studies suggest:

- improved student attendance and discipline
- increased student achievement
- higher student motivation and engagement
- improved student (and parent) attitudes to school
- more frequent student use of computers at home for school work.

*Our results indicate that the 1:1 students to networked laptop ratio contributes generally and significantly to the effectiveness of the learning environments per the design criteria of being more learner-, assessment-, community- and knowledge-centred. (Dunleavy, Dextert & Heinecket, 2007)*

Research findings by Owen, Farsail, Knezek & Christensen (2005) note that as students don't have to wait for teachers to convey information—much of it is available on the internet—forces a focus on the changing role of the teacher. If educators think differently about learning environments, there are opportunities for differentiated instruction and engaging learning.

Wireless-connected laptops can provide students with access to a vast array of information enabling them to work quickly and independently on set topics as well as pursuing particular points of interest. There are now unrivalled possibilities for students to collaborate and interact with others, building knowledge and understandings within a class, between classes and beyond. And, there is an increasing variety of technologies to encourage students to reflect on their ideas deepening their understanding of concepts and ideas, explore and experiment, and communicate their ideas in creative multimodal ways. There is now, arguably, limitless potential for engaging students in meaningful, relevant technology-enabled education.

*With 1-to-1, we're tapping into the children's world. We're using the tools that are part of their everyday life to motivate them to achieve their best. NSW teacher*

Laptops can also be used to strengthen the links between home and school, increasing communication and accountability with students and parents. Students are able to use their laptops as a tool to file and organise their school work independently at school and at home adding to the sense of home-school continuity.

*Now we have a feel for the potential of a one-to-one computing environment but how does this affect student learning? This is the subject of the next section.*



## EFFECTS ON STUDENT LEARNING

There are many studies focusing on the impacts on student learning in one-to-one laptop programs drawing on information from multiple sources, such as interviews, surveys and classroom observations. Where there are differences in results, they reflect differences in critical factors (e.g. educational leadership) laptop provision (e.g. mobile laptop carts, school-leased laptops), technical issues (e.g. connectivity) and variations in institutional requirements (e.g. standards testing).

*There is substantial evidence that using technology as an instructional tool enhances student learning and educational outcomes. (Gulek & Demirtas, 2005)*

Overwhelmingly, studies of laptop programs indicate many positive effects for students. Findings from these indicate that students:

- write more extensively with improved quality
- have increased engagement in learning
- are more interested in learning
- focus on improving their performance
- work collaboratively, as they are more willing to share their work and help each other
- engage more in self-directed learning
- have greater self confidence and self esteem
- have greater ICT skills
- improve their research skills
- are more enthusiastic and have fun learning
- improve problem solving and critical thinking skills
- are engaged in more project-based work
- enjoy learning actively.

*We all know that ICT engages children and engagement, of course, is the key to successful teaching. (Holmes, 2008)*

With teacher expertise, technology can be a tool that adds another dimension to student learning engaging students in their learning and making connections between what they are learning and the world beyond the classroom. Motivated students have control over their learning and are challenged with a series of goals and the ability to share their learning with others taking the chance to be recognised and to be proud of the work they have done.

The study by Gulek & Demirtas (2005) indicates that student learning and ability to transfer knowledge across subject areas can be enhanced by laptops as a result of project-based work which is collaborative and includes problem-solving and critical thinking.

In a study from Maine in 2004 with over 12 000 returned surveys, changes in student's attitudes and work habits was documented. Percentages of students agreeing with the statements follow:

- 'I would rather use my laptop' 80%
- 'Laptops help me be better organised' 75%
- 'Laptops improve the quality of my work' 70%
- 'I do more work when I use my laptop' 70%
- 'I am more likely to edit my work with a laptop' 80%
- 'I am more involved in school with a laptop' 70%
- 'Laptops make school more interesting' 70%

Another survey of student opinions (850+) in a study in California showed some very positive responses to the laptop program:

- 'Having a laptop helps keep me organised' 75% agreed
- 'I would rather not use my laptop' 78% disagreed
- 'I prefer to write assignments by hand instead of typing them on my laptop' 70% disagreed
- 'I am more likely to revise/edit my work when I use my laptop' 73% agreed.

*What is so encouraging is the progressive interaction: A student inspired by the class used his laptop at the first opportunity to do more research, then shared it with his teacher. Another student then visited that site and had a 'real life' learning experience. Without the laptop to use for quick access, the first student might have forgotten his interest in class and not found the website. Consequently, the second student would not have gotten the address and missed an eye opening moment. West Point teacher*

Zucker & Hug (2007) also report that students are very positive about the use of laptops. Many students believed using laptops had a very positive impact on how much they learned and influenced how well they could work with others at school.

Teachers involved in the Zucker & Hug study (2007), reported positive impacts on students using laptops for learning. Most teachers agreed there were increased opportunities for students to apply their knowledge and to think creatively helping to prepare their students for life in the 21st century.

As well, a one-to-one laptop program was seen as providing opportunities for teachers to revamp their professional practice. The teachers reported they are better able to meet the needs of students that are struggling and those that are gifted as they are able to spend more time individualising instruction for students.

In another study, Grimes & Marschauer (2008) sought teachers' responses in a comparison of teaching with laptops to prior experience without laptops. The percentages of teachers that agreed with the statements follows:

- 'Students spent more time giving presentations' 74%
- 'Students are more interested in class' 84%
- 'Students help each other more' 84%
- 'Students take more initiative outside of class time' 65%
- 'Students writing quality is better' 57%
- 'Students overall quality of work is better' 65%
- 'Students get more involved in in-depth research' 85%
- 'Students work harder at their assignments' 79%
- 'Students revise their work more' 78%

Wireless-enabled laptops provide students with frequent and immediate access to the internet and educational software. Penuel (2006) proposed that this places digital technology in an integral position in relation to student learning and teacher instruction. With increased access to resources to support student learning and tools to plan and organise learning, students can communicate with their peers, teachers and the wider community and undertake collaborative tasks in ways never imagined before.

*Now we know more about the potential effects of using laptops on students learning, let's look at what students actually do with their laptops.*

## CLASSROOM USES OF LAPTOPS

*None of the current curriculum will disappear, but the laptops will provide teachers and students with choice in their learning. A 1-to-1 laptop program means you have a range of ways to complete any set task. (Holmes, 2008)*

Integration of digital technologies into teaching programs can expand the repertoire of learning activities for students. In the classroom, teachers guide and become partners in learning; students are the architects of their learning with their laptop as the toolbox. However, laptops should never become the focus of the class. Sometimes laptops are not the best teaching and learning tool. Teachers should confidently use the most appropriate medium for the classroom activity.

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### COMMON ACTIVITIES

Writing is one of the most common uses of laptops in classrooms with many teachers reporting that students are more inclined to revise their work. Taking notes during the lesson using word processing software can be a faster, more efficient way of recording ideas and information than handwriting. Students should continue to write by hand, but digital technologies provide an increased variety of ways for creative expression extending writing skills. As well, writing completed on a laptop is much easier for teachers to assess and provide feedback.

*Our study suggests that introduction of laptops has an important impact on students' access to and use of information and data in instruction and research. (Grimes & Warschuer, 2008)*

Students often use laptops to access information to conduct research and support just-in-time learning. The search for background information to contextualise learning can be undertaken by students using laptops with internet access in addition to resources provided by teachers. Students are able to access information at the point of need, which can provide current data and a wider variety of resources than may be available in the classroom. Students can access online databases, track satellites, download images, record and analyse data using spreadsheets, watch online video and listen to podcasts. Many teachers believe that students get more involved in in-depth research using laptops.

Students researching on the internet use search engines to access informative and interesting websites to generate discussion, consolidate knowledge, extend and enhance existing knowledge and link to new knowledge. Students can locate background information for the next lesson and complete homework, assignments and assessment tasks. Well-developed information literacy skills of locating, selecting, evaluating and synthesising information are, of course, important factors in student success.

Students using laptops have opportunities to create content using multimedia tools for creative expression, presentations, project work, narratives and more. Students can design and create multimedia presentations to make and edit digital movies and images and create personal webpages.

Class websites can be used to publish student work, post assignments as well as provide a collaborative workspace. These websites can also contain course materials, outlines, calendars, work samples and photographs.

A compelling use of laptops is to extend students real-world learning by taking virtual tours, viewing simulations or movies and manipulating 3D models to visualise molecules, for example. Students can experiment with animations to assist understanding of concepts, providing context and meaning. Simulations, animations and movies engage students' senses and stimulate thinking through real-world

problems. Students can learn about difficult concepts, interpret content and create knowledge through online access to maps, video, audio, images, simulations, animations and text.

The classroom use of educational software is sometimes popular with students using laptops. These programs can provide self-paced individual instruction with feedback, scaffolds and other tools to enhance learning. This can provide opportunities for formative assessment of students and increase student interaction and engagement. Ideally, students can learn in an environment that matches their cognitive ability.

In some cases, scaffolds provide examples of mastery and opportunities for students to refine their understanding of expectations. As students work individually, they can seek assistance privately encouraging them to extend their learning in ways they may be reluctant to do in front of their peers.

Some software provides grading and reporting to assist teachers to implement remediation or extension activities for students and it may identify content areas that need to be targeted for direct instruction. Peer collaboration is also supported as students work together to offer assistance in solving problems.

There can be major weaknesses in the use of commercially available educational software, however. An important consideration is the choice of product to ensure that it is suitable, ensuring curriculum alignment with an appropriate pedagogical approach. Software programs are not proxy instructors relieving teachers of their responsibilities. The teacher's role is very important as the software program can never replace good teaching. Software programs cannot understand how students arrived at their answers to quizzes; teacher expertise is required to intervene to find out at which point students are failing.

One-to-one laptop environments can provide added value to formative assessment with improved frequency and quality of the assessments and reduced time and effort.

Dunleavy, Dextert & Heineket (2007) report that teachers have greater opportunities to individualise instruction when student use computer applications with embedded scaffolding and coaching features greatly improving teachers' ability to target remediation swiftly and efficiently.

Zucker & Hug (2007) study found that teachers using computers for assessment believe that they provided more timely, detailed and complete feedback to students more often with electronic students' products easier to assess.

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## SUBJECT-SPECIFIC CONSIDERATIONS

How often students use their laptops in class varies. In the Grimes & Warschauer (2008) study, estimates ranged from 70% by English language arts teachers to 23% of class time for mathematics teachers. Zucker & Hug (2007) report the greatest use of laptops was in English and humanities, history, mathematics and science.

The impact of technology varies between different subject areas. This may be due to range of factors which could include the availability of suitable digital content, readiness of teachers to integrate ICT in teaching and their classroom experience.

The McGrail study (2007) explored how laptops influenced English language arts teachers beliefs about teaching and how this was practiced in a laptop program. Focusing primarily on teacher's pedagogy with laptop technology when examining the off-task behavior, limited communication and social isolation seen in some English language arts classrooms, McGrail concluded that teachers needed to have an understanding of the meaningful integration of technology.

This illustrates the importance of teachers evaluating when and how to infuse the technology in context rather than separating the function of technology in the learning environment.

There is a mix of findings from other studies relating to English classrooms possibly due to differences in the nature of the laptop program and differing research aims. Gulek & Demirtas (2005) found that students in laptop programs achieved significantly higher test scores in English language arts and mathematics. Dunleavy and Heinecke (2007) report that one-to-one laptop classrooms are more effective in increasing English and writing achievement for male students than female students. Zucker & Hug (2007) found that almost all English teachers ask students to use the computer for writing frequently. It seems that there are many more parts to the puzzle to gain a comprehensive insight into the influence of laptops on learning in the English classroom.

The way that laptops are used often depends on the demands of the subject. In mathematics, students often do drill and practice exercises; many history students conduct research daily; and students in the English classroom often use laptops for writing.

Zucker & Hug (2007) described physics students using technology extensively in class to collect data, analyse and present real-time data, manipulate laboratory simulations encouraging experimentation and visualisation of physics concepts. These students use their laptops to communicate about science almost daily. Students believed that interactive lessons using technology better enabled them to understand concepts.

Recognising the potential of integrating learning with laptops is critical to the learning environment. For example, in science students can be alleviated of the tedium of some tasks by word processing experimental reports and using databases, spreadsheets, simulations and multimedia for collecting and analysing data bringing authenticity to the learning experience.

*So far we have explored research relating to the impacts of students learning by the use of laptops and what students can actually do with laptops in the classroom. A successful implementation of a laptop program is, of course, integral to the realisation of these benefits. What are the factors that influence a successful implementation? Read on ...*

## FACTORS INFLUENCING SUCCESSFUL IMPLEMENTATION

One of the major obstacles to the change in access to digital technology will be in changing the learning environment for students. It may not be immediately apparent to teachers how laptops can be used as learning tools.

Owen, Farsail, Knezek & Christensen (2005) acknowledged that change is hard and it may take time and it may not be right first time! Ongoing professional learning and support are very important factors essential in changing teacher's attitudes and practice. Teachers need to believe that technology can transform teaching and learning into a current, relevant and highly engaging experience for students.

There are a number of factors that can influence teacher uptake of technology and its integration into teaching and learning. These factors fall into the following categories: teacher's attitudes and beliefs; school leadership; classroom management strategies; and technical support. Pivotal to a successful implementation is the provision of ongoing professional learning which will be explored in detail in the next section.

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### TEACHERS' ATTITUDES AND BELIEFS

Penuel (2006) described the influence on teacher's attitudes and beliefs as what they hear and how often. Teacher professional learning is a very important source of that information. A teacher's pedagogical approach and subject-matter expertise can also influence uptake of technology. Teachers need to be aware of and convinced that laptops can enhance teaching and learning, feel confident and prepared and take an active role in professional learning which must be closely aligned to curriculum. Then, teachers are more likely to integrate technology into their practice.

Teachers are also influenced by beliefs about student capabilities of using computers. Teachers who believe their students are capable of independent and collaborative tasks are more likely to allow students to choose topics to research and set extended tasks for laptops. However, teachers can modify their attitudes after seeing what students can do with multimedia tools and start to set more challenging, extended tasks.

In Australia, students show a great range of skills and capabilities when using ICT. Most students that took part in the National Assessment Program in ICT literacy in 2005 reported using computers for at least three years. Many of these students were also frequent users of computers though this was more likely to be at home rather than school for both Year 6 and Year 10 students. Across Australia, 61.2% of these students were at or above the standard (level 4 of the ICT proficiency standards and above) with NSW students being close to these percentages.

Teachers have concerns about students' use of computers in tasks not related to research and learning where a focus on policing student's online behavior can distract from the content of the lesson and erode trust.

Another area of concern is the negative impact on students learning with reduced face-to-face interaction when students' time is spent on computers lessening social engagement between peers.

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## SCHOOL LEADERSHIP

*One of the most important study findings is that the school has worked hard to put in place the supports necessary to develop and sustain a successful 1:1 laptop program. The school had a compelling vision of how laptops can contribute to students' and teachers' work. Teachers are encouraged to be innovators and partners in the 1:1 program. The laptops themselves ... are part of a complex interconnected web of devices, networks, activities, and goals whose purpose is to support the school community's efforts to carry out its ambitious mission. Laptops do not stand alone. (Zucker & Hug, 2007)*

Many educators believe that successful programs rely on effective school leadership. Lile (2008) found that it is important to develop a school vision incorporating the school community's expectations for a laptop program. The purpose of a laptop program should come from identified student needs in relation to areas for academic improvement. Integration of technology should be aligned to curriculum in a meaningful way. This takes time and often begins with increased use of laptops in teaching and learning. This can be built upon by encouraging teacher reflection and sharing ideas to improve student engagement and learning. Extensive professional learning opportunities are essential in building teacher capacity. School leaders should continue to learn by visiting other schools, talking to other school leaders and by going to conferences to learn more about how technology can be used to achieve school's goals.

The support by effective school leaders of new and ambitious programs such as one-to-one laptop initiatives is essential. Lessons learned from implementing one-to-one computing in the Maine Learning Technology Initiative include:

- Principals and others must model the use of the technology tools they expect teachers to use.
- Leaders must be consistent in their support for the initiative.
- Clear and reasonable expectations of the program must be communicated to avoid confusion.
- Professional development, time and resources are required to support an effective implementation.
- Support should be given to early adopters and risk takers allowing them to work together and to share their information and spread enthusiasm among other staff.
- School leaders must be active and public supporters of the program clearly articulating how integrating technology provides educational benefits, showing students work as evidence and highlighting best practice.

Toy (2008) proposes that these strategies can be broadened to empower others to take a role in moving the vision forward implementing the initiative in the classroom, collaborating with colleagues and talking to the community.

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## CLASSROOM MANAGEMENT STRATEGIES

Laptops can provide disruptive and competitive distractions in class, requiring teachers with strong classroom management skills to reduce the occurrence and impact. Classroom management is an issue when students have control of what information they seek and when they search.

Research as far back as the 1970s confirms teachers' views that students have limited ability to engage in simultaneous tasks. When students are not engaged, they talk, write notes and look out the window. This is not new. However, students will be assisted to new heights (or depths) by laptops compounding the struggle for teachers grappling with technology-rich classroom etiquette.



The research study conducted by Hembrooke and Gay (2003) showed that students who were allowed to regulate their use of laptops during class did not perform as well in memory tests as students who were told to close their laptops. The study explored students using laptops browsing behavior and found a relationship between browsing efficiency and performance. Time and practice improves students browsing ability. Interestingly, students using laptops who performed poorly in the memory test had otherwise good grades when they normally multitasked during lectures to supplement their learning.

Some classroom management strategies suggested by teachers include:

- Publish a set of rules relating to laptop use.
- Students must put their screens down when doing non-computer tasks to focus their attention.
- Teachers circulate around the class to monitor students' screens and online behaviour.
- When setting an activity with a complex set of steps, teachers can post instructions on class website and on the wall of the classroom, thus reducing time spent in repeatedly giving directions and procedural instructions.

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## TECHNICAL SUPPORT

Many teachers report frequent technical problems which hinder learning. Other influences include reliability of wireless network and access to timely technical assistance.

In classrooms, some teachers and students are able to problem solve to handle routine technical issues with school-based technical support providing additional assistance.

*One of the most influential factors contributing to the success of the implementation a laptop program is the support for teachers. This is the focus of the next section.*



## SUPPORT FOR TEACHERS

*One cannot assume that our K-12 teachers have either the 21st century skills or the natural capacity to change their teaching methods simply upon demand. Only through professional development and with the support of the school leadership can these changes in the classroom occur. (Barrios, 2004)*

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### A SUCCESSFUL IMPLEMENTATION WILL TAKE TIME

Teachers may be enthusiastic but the initial implementation of a laptop program requires time and effort. Teachers should prepare for a long, slow program of learning as an interactive, accretive process accumulating practical skills for effective classroom teaching. Teachers need time to adjust to new technologies, reorganise themselves, explore changes in classroom management as well as transform their pedagogy to suit a new learning environment that's more collaborative, cooperative and project-driven. Experimentation, reflection on practice, independent study and curriculum development are all important factors contributing to this ongoing professional learning.

Teachers prepared and receptive to professional learning are confident and highly skilled in classroom management, knowledgeable about their subject matter, flexible and open to new ideas.

Many reports indicate that teachers progress through stages in integrating technology. Penuel (2006) found that teachers commonly start by adapting traditional teaching strategies rather than embracing collaborative, project-based learning environments. With support, teachers are encouraged to explore different ways to cover address curriculum and extend students thinking using technology. In time, teachers imagine other ways to use technology as a teaching tool creating new learning environments in their classrooms.

Teachers with high ICT skill levels may still require professional learning to discover teaching and assessment strategies, resources and classroom management strategies which are effective in a one-to-one laptop environment.

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### FEATURES OF A PROFESSIONAL LEARNING MODEL

The key to success is more than the technology. A successful implementation must be approached from an instructional rather than technical position. The focus should be on how to use new hardware and software to improve teaching and learning, rather than simply learning the basics. Integration of technology into teaching and learning is not guaranteed by the provision of technology tools. Targeted ongoing support for teachers is required.

Valuable teacher professional learning has a focus on:

- transforming pedagogy to help teachers develop problem-based learning tasks which require student collaboration to find solutions or create products using digital technology
- integrating technology into teaching and learning in a subject-based context relevant to student's lives
- exploring how technology can facilitate new learning activities and enhance existing strategies
- examining how computer-based learning affects how students process information and how they interact with others
- supporting teachers co-constructing knowledge with peers and working together to collaborate, share ideas, strategies and skills
- assisting teachers to find relevant resources
- developing teachers' ICT skills.

For professional learning to be successful, it needs to be ongoing and include courses, defined goals and expectations, models and motivation for change (perhaps tied to regional and school leadership) and linked to school's curriculum goals.

Teachers also need support in thinking about changing classroom assessment through the use of technology-rich authentic assessments integrated into learning activities. One-to-one laptop implementation requires a shift in the kind of teaching strategies that are successful in this context.

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#### MODELING EFFECTIVE PRACTICE

Swan, Kratcoski, Mazzer and Schenker (2005) describe professional learning about educational technology and its integration into teaching and learning as focusing on learning in context situated in authentic classroom practice. This approach involves teachers working with experts to become familiar with available technology and develop lessons integrating technologies appropriate to the learning outcomes. Ongoing peer support helps lesson planning and encourages teacher reflection.

Ongoing, hands-on professional learning where teachers learn applications in the context of an actual project is very effective – teachers also need a problem-based, authentic task of real-world significance to aid their learning.

Teachers should be prepared to take risks as we expect our students to; teachers need to model this behavior but that isn't going to be easy. Open-ended student activities involving teachers as the facilitators of deep learning, exploring alongside their students, linking to real-world knowledge could be a starting point.

Collegial groups are important as they can find appropriate resources and develop lesson to align to syllabuses for teachers in their local area, sharing their knowledge as a collaborative working group. Teaching innovation thrives where teachers are experimenting technology-rich environment.

Teachers can become more confident in integrating laptops into lessons from hearing and seeing effective strategies in operation. A 'show-and-tell' faculty approach sharing practice and sample lesson plans support teachers in using laptops to facilitate learning in their classrooms.

Examples of this support can be found in the following websites:

- Video clips of subject-area integration and project-based learning and teachers discussing their classroom management strategies are posted on <http://www.irvingisd.net/onezone>.
- [No strings attached: wireless laptops in education](#) showing videos of sample lessons taped in Florida schools with syllabus links and a description of the lesson objectives and procedure.
- The [Laptop learning challenge](#) website provides lesson plans for mathematics and science.

## CONCLUSION

This review examined literature from various studies mainly in the United States focusing on learning with laptops. These studies reveal many different approaches demonstrating the complexity of implementing a laptop program in the educational context. Whilst there are many variations in these reports, common throughout are descriptions of the considerable potential for improved student learning.

In a technology-rich classroom where students have immediate and frequent access to the internet and educational software there is potential for a transformation of the learning environment to improve student learning outcomes. There are opportunities for a broader range of activities where students use higher-order cognitive skills to construct meaning and work on collaborative inquiry-based projects which have meaning beyond school.

Another common theme throughout the literature is that a successful implementation will take time and require effort. This may be an interactive, iterative process where teachers adjust to new technologies, explore new ways to meet curriculum needs, develop approaches to extend students thinking using technology, and transform their pedagogy to suit a new learning environment in their classrooms.

Integration of interactive technologies into teaching and learning is not guaranteed by the provision of technology tools. It cannot be assumed that teachers have the 21st century skills or ability to change their teaching practices rapidly. Ongoing professional learning, time and the support of the school leadership are factors critical to success but the educational rewards will be great!

## REFERENCE LIST

1. Barrios T 2004, [Laptops for learning: final report and recommendations of the laptops for learning task force March 22, 2004](#), Florida Department of Education, United States.

This is the report of the taskforce that assessed the use of mobile computing in Florida schools in relation to student achievement. It also identifies best practice from other initiatives throughout the US.

2. Bielefeldt T 2006, *Teaching, learning and one-to-one computing*, International Society for Technology in Education

Background paper for the *Ubiquitous computing: near future and far horizons* conference, San Diego in July 2006.

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This paper describes laptop classes in colleges and universities and gives some suggestions of how to incorporate this technology into classes.

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