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# Transforming schooling with 1:1 mobile computer support.

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**Abstract**: This paper discusses a range of issues around 1:1 student to computing devices programs in schools and reports on the critical factors that will contribute to the success of this approach. The researcher was privileged to evaluate one of the early adopter laptop programs and then follow-up by evaluating the first program in a Western Australian government school. Research has found that while the 1:1 model does tend to better realise the potential of the technology doing so in real school settings is not a trivial matter and those responsible need to consider, and plan for, a range of factors.

**Keywords**: mobile learning; one-to-one programs; computer supported learning

## Introduction

At the beginning of the 1990s the first Australian school embarked on a journey to realize the dream of providing every student with a powerful computing device to support their learning [11]. At that time the device was a laptop, wireless networking was not available, and the devices were heavy and expensive. However, the vision was that in time all students would have an anytime-anywhere computing device and that this would transform schooling. It has taken over 20 years for it to be a realistic possibility in secondary schools where the national government has now provided funding support. While not all schools have used this to provide 1:1 mobile computing this is fast becoming the norm. There are many schools still choosing to invest in laboratories but clearly now the cost effectiveness of the mobile options are superior as discussed by Becker [1].

## 1. The research behind 1:1 mobile computing in schools

The concept of mobile computing has developed recently to mean that a person has access to a computing device, their data, software to use with their data, and communication services anytime, anywhere. The 1:1 in schools means mobile computing for each student. This level of ubiquitous access to personal data files and appropriate software and hardware where and when needed in reality may involve one of a number of devices such as a notebook computer or mobile phone. In education 1:1 has been pursued to provide the flexibility and educational focus that tends to be lacking in the computer laboratory and to better align with more constructivist-based teaching strategies (e.g. [3] [20]. There has been much research that has pointed to the potential of digital technologies to support improvements in learning outcomes, however, largely this effect has been small or for small groups of students [2]. More recently research has found a larger and more consistent effect for 1:1 computer use (e.g. [3]). A key additional attribute of portable

devices is that almost certainly the student controls the device. If the device stays with them it is likely that they will personalise and become very familiar with its operation. This shifts the control in the learning environment towards students.

The use of portable computing devices provides both students and teachers with additional opportunities. For students it provides a means of maintaining their own data and customising software tools and having them available at all times. For teachers it provides the ultimate flexibility of access where they can organise activities requiring any student:computer ratio at any time. There is no need to book specific rooms, roster access, or artificially organise the learning schedule around the available access. While mobile computing overcomes some obstacles to computer use but there are still some obstacles to overcome. For example, those responsible for the maintenance of systems tend to want standardisation with no user control while educators want environments within which the learner has maximum control [15]. This issue and a number of others need to be considered within the light of the findings of research to ensure the deployment of 1:1 mobile computing transforms schooling to substantially improve learning outcomes.

Since the early 1990s there has been much research into the use of portable computer devices in schools, mostly with positive findings (e.g. [12]). This area of research then expanded to include the use of smaller devices [18]. The inclusion of associated technologies such as wireless networking have further enhanced the potential of portable devices in schools [14]. Initially most of the research in Australia was conducted in private schools due to the high cost of the technology but even from the mid-1990s there have been some government schools [21]. The author was involved in evaluating the first 1:1 program in Western Australia from 1993 to 1997 in a private school and then the first whole of government school program commencing in 2003 [16]. Since then an increasing number of schools have been moving towards such programs, nowhere more widespread than in New South Wales where every student in government schools from Years 9 to 12 has been given a netbook, software and wireless networking [8].

Initially the research tended to be qualitative and small-scale focusing on the impact of particular devices on teachers, students, aspects of schools and learning environments (e.g. [7]). Increasingly more traditional empirical research has been conducted, starting with the comprehensive study conducted by Walker, Rockman, and Chessler [23] that compared ‘laptop' with ‘non-laptop' schools. Another notable more recent example was the longitudinal study by Lei and Zhao [1] in a ‘mature’ 1:1 school that found that more use of notebook computers could translate into increases in grades. Much research on ICT use has reported the need to overcome obstacles to gain the affordances (e.g. [2]), however, increasingly studies have found that mobility realises additional affordances leading to more use, and a greater range of use (e.g. 19]). While in the early years there were positive, but not compelling findings, of impact on achievement, more recently the findings have been more compelling (e.g. [6]). It has usually been found that portable devices have best supported process-oriented outcomes such as collaboration and problem-solving rather than content-oriented outcomes [5]. If a move in this direction is valued, this provides a rationale for the use of 1:1 mobile computing.

## 2. Long-term success stories in Western Australia

The author was privileged to evaluate the first 1:1 program in Western Australia and then the first 1:1 program in a public school in the state. Both programs were eventually successful and have continued to evolve to the present day. However, initially the findings were disappointing where apart from isolated teachers there was very little change at the classroom level that could be attributed to the presence of the computers

(e.g. 21). The study suggested that this underuse was due to the teacher's preferred pedagogy, their lack of experience and knowledge in using computers in the classroom, and a lack of time to experiment with computer applications. Computer use predominantly supported student-centred learning environments.

In 2003 the first 1:1 program at a government secondary school (School J) commenced [16]. The program included the appointment of a 'Curriculum Director' who had knowledge and experience in integrating the use of ICT in teaching and learning. The evaluation of the program involved collecting similar sets of data each year, a method reported by Newhouse and Clarkson [17]. From the first year the evaluation found readily identifiable and quantifiable indications of a positive impact of the program on teaching and learning. There was almost a tripling to 45% in the proportion of teachers indicating facilitating some computer use on a daily basis. Student estimates of computer use at school indicated almost a doubling to nearly two hours per day. Most teachers and students routinely accessed online information sources and the ICT competencies of teachers improved substantially with an average increase of 28% on the measure used.

Using the *Learning Outcomes and Pedagogy Attributes* (LOPA) measure [17] it was found that by the end of the third year the score had risen by 174% on the baseline to 27 (c.f. a range of 0 to 19 at other secondary schools). About half the teachers were facilitating computer use to support the investigation of the real world and to increase student productivity, and about one third were doing so to increase student engagement and authentic assessment. There was substantially greater focus on knowledge building, student independence and collaboration. For a few teachers integration had become routine, well planned, learning outcome and student-centred, while over 85% indicated a sense of confidence.

However, there were still a few difficulties, in particular by the third year the level of breakdown and repairs and short battery life. About half the teachers indicated that student characteristics such as behaviour and capability were constraints. There was a group of about 15% of students who either didn't like using computers, didn't want to carry a computer, didn't think they were used enough, or didn't think they had learned enough about how to use them. Despite this at the end of the third year the program was reviewed and renewed for another three years. During this second period of three years an evaluation showed that the earlier gains were maintained although the school struggled to counter the natural rate of turnover of staff. At the end of the second lot of three years the 1:1 program was extended again and is likely to be a permanent feature of the school.

## 3. The key issues for 1:1 mobile computing in schools

In Australia schools have benefitted from the results of research since the early 1990s to address the key issues for 1:1 mobile computing. Newhouse [15] referred to these as barriers, that may be removeable obstacles or opposing forces that need to be countered. Barriers were classified as technical, personal knowledge and skills, organisational, or pedagogical.

*Technical barriers* such as battery life, screen brightness, weight, reliability, durability, and access to networking have largely been overcome [14]. The improvement of wireless networking has removed many technical barriers. However, more recent research still finds that some classrooms are too cluttered or have desks that are too small, and have insufficient power outages. There are also management problems such as repairs, access to printers, incompatibility of software, software licensing, and organisation of data storage. Sometimes technical issues of durability and ergonomics need to be addressed.

*Personal knowledge and skills barriers* associated with teachers have been well documented for decades. However, early research focussed on the operation of hardware and software rather than a deficiency in understanding of the technology and experience in integrating with the curriculum and implementing in learning environments. Where student-owned portable computers are being used, a lack of operational skill by teachers is not as critical because the students know how to operate their computers and don't need to rely on the teacher, as was the case at School J [17]. However, students become dissatisfied if teachers do not facilitate adequate computer use. This obstacle can be readily removed by providing teachers with both technical and curriculum support [20].

*Organizational barriers* such as short time periods, disintegrated curriculum, segregated curriculum specialist teachers, and bureaucratic management of digital resources and support, are all removable obstacles. At School J most of these were removed by the curriculum integration role of the Curriculum Director and the use of a sub-school structure affording a reasonable level of flexible autonomy [17]. In general computer use is best suited by flexible access, longer time periods, integrated learning on substantial activities.

*Pedagogical barriers* concern curriculum, pedagogical practices and teacher beliefs. Research has tended to find that digital technologies are more strongly aligned with student-centred constructivist pedagogies (e.g. [20]). The curriculum area and assessment requirements are major determinants of the amount of computer use and the breadth of applications used. For example, students are more likely to use the computers for classes associated with curriculum in which teachers require a substantial amount of investigation, document production and practical work. Where external, hand-written, short-term exams dominate assessment, computers are less likely to be used. As a result of teacher perceptions computers are less likely to be used in classes with older, higher ability students than younger and/or lower ability students. These barriers are more difficult to remove as they are related to sets of personal and organizational beliefs that may become an opposing force to be confronted. Inan, and Lowther [9] estimated that teacher readiness and teacher beliefs explained 0.84 of the variance in 'laptop integration'.

## 4. Conclusions

After over 20 years of evidence clearly indicating the success of 1:1 programs there is a basis for widespread implementation in secondary schools. If the aim is to use ICT to support more student-centred constructivist learning environments and empower children as learners then clearly an approach that works is the provision of portable devices supported by reliable networks, appropriate software, adequate technical support, informed school leadership, skilled and effective curriculum leadership, well prepared teachers, and included local communities. With the reduction in cost of the devices the ownership question is increasingly coming down on the side of student. Other questions are which type of device is appropriate for students and what components of a system need to be carried by the student and which should be left on the server? Whatever the case these questions should be almost the last questions, the first should concern developing a vision for how ICT will support teaching and learning.

Research is increasingly demonstrating that ICT can offer substantial support to learning environments in schools, but that there are obstacles and opposing forces to this support being realised. To adequately realise this potential a level of investment is required that provides ubiquitous access and appropriate software, along with the necessary professional support. Mobile computer systems offer a successful means of providing such ubiquitous access in schools and removing many of the obstacles. If we

decide that our children do need better schooling and that computer support will assist in providing this, then 1:1 mobile computing will realise the potential so long envisaged.

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