Laptop classes in some Australian government primary schools

ABSTRACT

Australia was once a world leader for laptop adoption in schools. Now overtaken by extensive roll-outs of laptops in Maine and Uruguay, this paper seeks to explain why this lead was lost. Six case studies of government primary schools were undertaken to gather data about current initiatives. Comparative analysis shows how the potential of laptop-based schooling can be conflicted through concerns about curriculum direction and equity. The lack of congruence between the affordances of ICT and conventional curriculum constraints are suggested as the reason why Australia lacks focus in this area.

Andrew E. Fluck

Andrew.Fluck@utas.edu.au

Faculty of Education, University of Tasmania

INTRODUCTION

Methodist Ladies Presbyterian College in Melbourne is often credited as the first school in Australia to introduce laptop computers into the classroom. This independent school provided computers to students at a 1:1 ratio from 1989 when all incoming students in grades 5 through 12 were required to purchase a school-approved Toshiba laptop (Stager, 1998). This early lead in an independent Australian school failed to be adopted on a much larger scale until the 2009 *Digital Education Revolution* policy started providing computers to students in Years 9-12 (Rudd, Smith & Conroy, 2007). This approach in secondary education has no corresponding national scheme for primary schools, nor does it mandate 1:1 personal allocation of computers to individual students.

In 2002 the US state of Maine became the first to scale up 1:1 computing by mandating a laptop for every student in seventh grade (Johnstone, 2003, p.4). Subsequent nation-scale adoptions have seen every student in Uruguayan primary and secondary schools issued with a One-Laptop-Per-Child computer (Kraemer, Dedrick, & Sharma, 2009, p.70).

These three situations mark the evolution of a meme from a privileged school where parents pay considerable fees; to government schools in a wealthy country; and finally to government schools in a newly developing country with a per capita gross domestic product only twenty percent that of Australia (World Bank, 2008).

It is therefore salutary to examine some few government primary schools in Australia which have adopted laptop computers to understand their implementation models and experiences. Unsupported by regional or sectoral strategies, a case study approach could reveal the driving forces behind their individual 1:1 adoption and any curriculum impact. Sample schools were found in the states of Victoria, New South Wales and Queensland (other states and territories were beyond the fiscal or time scope of the study). Pseudonyms have been used for all of these schools. 'Laptops' has been used to indicate a range of portable computers, including netbooks.

Approach

Contact was made with the principals of six primary schools located through a search on the world wide web and identified as having at least a full class of students with individual laptop computers. These principals agreed to host a one-day visit from the researcher in the period May-July 2009. Each visit comprised at least one observation session in a classroom when computers were used for learning, together with an interview with the main class teacher. The following table gives details of the schools (Table 1).

As a result of these visits, a case study was written up synthesizing the information from each school. This was checked by the key contact at the school and subsequently

Table 1: The case study schools

School	ICSEA range	State	Location	Laptop class
Cadillac Fountains State School	970-980	Queensland	Metropolitan	All classes
Oceanview Public School	990-1000	New South Wales	Metropolitan	Year 6
Duxton Primary	1000-1010	Victoria	Provincial	Year 6
Arboreal Way Primary School	1000-1010	Victoria	Provincial	Year 5 students in a composite Year 5/6 class
River Fields Public School	1020-1030	New South Wales	Metropolitan	All Years
Jumbuk State School	1090-1100	Queensland	Metropolitan	Year 7

ICSEA = Index of Community Socio-Educational Advantage (ICSEA) a composite index of location and socio-economic status of the community. A higher value indicates greater advantage and proximity to an urban hub.

used as a teaching stimulus for a cohort of third year Bachelor of Education students. Anecdotally these pre-service teachers were amazed so many schools were supporting laptops to this extent. Responding to each case study, pre-service teachers were asked to place each school on a continuum for ICT integration – ICT transformation. This scale was constructed to provide a contextual metric for discussion, with only the extremes defined as in Table 2. Previously the students had expressed an interest in 'only learning what is actually happening in schools' when responding to teaching evaluation questionnaires. Therefore the teaching exercise extended their understanding of the range of ICT experience in schools, and encouraged them to look beyond present practice to strategically desirable objectives.

Table 2: The Integration-transformation scale

1 (ICT integration)	...	10 (ICT transformation)
Computers are rarely used, curriculum delivery, assessment and reporting do not assume or require computer use.		Computers are always used where relevant, the curriculum assumes this will be the case and often includes topics that require personal ICT use; assessment and reporting explicitly require and identify knowledge and skills that could not realistically be demonstrated without the use of ICT.

Typical uses of ICT in laptop primary schools

Two of the study sites had school-wide provision at a lower density than 1:1 or in a lab situation, and the other four concentrated laptops into the final year classes. In those that had a school-wide provision a systematic range of ICT was observed with evidence of a mapping between age and computer applications. In River Fields (see Figure 2) a Year 1 class was observed using ABC Reading Eggs[1] to support literacy learning. Pupils were clearly engaged, aware they had to progress by finishing 'maps' and attain higher 'levels'. Similar progression by ability was seen in a combined Year 1+2 class using the RainForest Maths program[2] with individual students allowed to progress to online competitions with Mathletics[3]. The seating plan put each Year 1 pupil between two Year 2 pupils for peer-tutoring as needed. In another Year 2 class 85% of pupils had engaged in Mathletics from home. They were taught to use the 'reply-to-all' function in e-mail. The class members were very excited to be sending messages to one another. Memetic spread was observed as some pupils used different fonts, colours and backgrounds. Year 5/6 pupils were engaging in Robotics.

Fig 1: Year 6 students at Oceanview

Online learning web-sites such as Mathletics were very popular in most schools, but can be criticised as providing practice rather than tuition. Teachers were very positive about them because pupils could progress individually, and the systems provide condensed reports about progress. Few teachers were able to comment on these reports, but general classroom observation showed them the level at which each pupil was succeeding.

The Year 5 students at Arboreal Way were taking digital photographs of picture story books, or scanning the pages, and putting them into a PhotoStory. The next step was to record the story and synchronise this with the pictures. Then the final product would be given to their younger buddies in the Year 3-4 class. One pupil demonstrated a movie she had made in ZimmerTwins[4] which she had worked on it at home since being introduced to the web-site.

At Cadillac Fountains pupils in a Year 5 class were observed finishing up technology reports for the end of term. Each had reviewed a chosen technology and provided a critique of its potential. Handwritten drafts were seen being transferred into PowerPoint or Microsoft WORD, with a variety of typing skills from two fingers to one handed (typing skills are practiced every second day using WORD). Full advantage was taken of spell-check facilities and illustrations from clip art were inserted. Pupils said most work uses Microsoft Office, but also talked of online curriculum software such as Mathletics where some had progressed to a Year 8 level (three years above their chronological age).

The Year 6 class at Oceanview were still mastering Touch Typing with nearly all pupils are typing more than 30 words a minute and some reaching 50-60 words a minute. This was generally achieved through the use of on-screen tutorials such as Typing Tournament for 10 minutes a day for about 3 weeks. Art classes were extended with elementary animation & movie making (using Pivot and Movie Maker) and digital photography was combined with image manipulation (using PaintShop Pro).

Online adaptive testing was used at Duxton with the netbooks enabling the class to do the test all at the same

1 http://readingeggs.com

2 http://www.blake.com.au/Rainforest-Maths-s/2186.htm

3 http://www.mathletics.com.au

4 http://www.zimmertwins.com/

time. Pupils used a notebook jotter to work out answers to the multiple-choice questions which were timed and the results translated into placements on the state curriculum attainment levels. A particularly impressive class project was an A4 colour digital portrait photo of each pupil which had been printed with the right hand side blank. Pupils used hand tools such as pencils and crayons to finish the portrait. Audacity was used to merge sound tracks from a library to create new music mashups; Wikipedia to find national flags to accurately illustrate writings about World War 1; Pivot to make short cartoon animations; playdough to make stop motion animations in teams. E-books were accessed online for private reading after lunch. Some pupils could give voice commands to start their internet browser.

At Jumbuk, three pupils presented interactive biographies created using hyperlinks between multiple Powerpoints. They were very confident with their work and found the creative process fun. They had used Tag Galaxy[5] to use the semantic web to find useful photographs and manipulated images with Photofunia[6]. Another class was very familiar with the virtual class, and showed expertise in using the online mind-mapping tool Bubbl.us, but others chose to use Word or PowerPoint for their task. One musically gifted pupil spoke highly of the 'virtual class' (a learning content management system used for reticulation of worksheets and other information), since it allowed him to catch up when concerts interrupted his attendance.

These examples show a diverse range of activities being undertaken in schools, many of which were only possible through the use of computers. Classroom management was predicated on every student having access to a laptop, and it is highly unlikely any of these learning activities could have been completed without this provision. Lesser computer provision would have been highly disruptive, with additional scheduling management needed from the teacher.

Some activities were at a lower cognitive level than others. For instance, touch typing is a manual dexterity skill justified by the need to master a new text production method which became superior to handwriting over time. Middle order thinking was supported by online practice web-sites. Higher order thinking (Education Queensland, 2002) was exhibited in the technology critiques and the use of various specific software applications for media creation and editing.

New Topics brought into the curriculum

Schools were asked to comment on the way laptops introduced new learning outcomes. This gave some measure of the way classroom learning time was actually used in a way that diverged from the standard curriculum. Some of the topics previously identified were mentioned at this point, but additional higher order thinking areas included:

- Ethical use of ICT, copyright awareness, plagiarism and referencing.
- Managing ICT – carrying delicate equipment carefully, avoiding contamination from sand, food etc.
- ICT infrastructure concepts – cabling, networking, hubs, servers, fibre optics, international connectivity.
- Podcast creation and peer review to improve reading skill.
- Vodcast creation/review to help develop understandings in Science.
- Wordle and crossword-creation software
- Inter-school competitive academic games (eg. Mathletics)
- Graphics with KidPix for Art & environmental science
- Elluminate7 web-conferencing to bring experts into the school classroom.

The observed activities and these identified 'new topics' can be divided into three groups. Firstly there are learning outcomes which are a study of ICT as a technology in itself, including ICT operation and social implications. Second, there are learning outcomes in which ICT is used to facilitate understandings in conventional curriculum areas such as Science, reading, mathematics or art. Finally, there are new ways of learning (such as web-conferencing with experts) and new topics such as robotics which point to a transformative effect upon curriculum.

New Pedagogies

It might be expected that new learning outcomes will be accompanied by new ways of organising the educational process and new teaching strategies. In Queensland, there was extensive use of the BlackBoard Virtual Class in *The Learning Place*[8]. This allows teachers to prepare schedules of activities (including homework) for the coming week, and place them online with links to online learning objects and other digital educational resources. Pupils can access these from home and school. The Virtual Class requires a lot of teacher prior preparation, but provides continuity in the case of absence and can be replicated in bulk for following years.

Taken to the extreme of a fully online course, this requires considerable prior preparation which is not provided through the standard *modus operandi* for teachers in schools. However, even at a basic level of providing a timetable for the week and identifying worksheets or activities, it can be very helpful in a conventional class.

Another example of ICT-based pedagogy was whole class marking facilitated by putting a good example on the interactive whiteboard for all pupils to share. Programs like

5 http://taggalaxy.de
6 http://www.photofunia.com/
7 http://www.elluminate.com
8 http://education.qld.gov.au/learningplace/index.html

Go Maths[9] were cited as a third new pedagogy, allowing pupils to progress at their own rates.

Teachers said they needed to spend additional time reviewing digital educational resources to select the best; however, once found these can be shared with other staff and schools very easily. This suits teachers with a pupil-centred approach; 'you are more a guide and facilitator', no longer the source of all knowledge and control. Pupils become more self-motivated – they push themselves harder. The digital environment was seen by teachers as better for longer continuous focused attention – not for 16 mad topics in a morning. One commented that "It's easier to cater for a mixed ability class, and the range of ability in specific subjects can be more extreme", due to the self-paced nature of learning through ICT.

Impact on learning

The impact on pupil learning with ICT could be measured using pre-existing curriculum accountability frameworks. It can also be reported by other measures, and teachers emphasised greater engagement with learning. At Arboreal Way, pupils with netbooks were more engaged with learning, and undertaking learning at home. For instance, two low-achieving girls used their netbooks to read at home and brought reflective reviews back to school. The teacher believed this type of activity will improve scores in the National Assessment Program – Literacy and Numeracy (NAPLAN)[10] for the cohort in the future.

It was also a hotly debated issue whether laptops or netbooks will lead to increased scores in the NAPLAN testing. In the main principals were wary of suggesting this should be used as a means of judging the efficacy of the computer-based learning. This is understandable, since NAPLAN testing is largely pen-on-paper, and handwriting skills may conceivably diminish when keyboards are more frequently used for text production. At Cadillac Fountains pupils recorded their own reading into podcasts, and then peer reviewed these audio tracks. This process subsequently produced noticeable improvements in reading skills which the teacher expected to translate into improved NAPLAN results.

Another area where impact on learning was noted was the individual feedback from computers which provided a supportive environment for pupils with ADHD-related symptoms. Where ICT facilitated individually negotiated learning, or individual progression according to ability, teachers were able to identify greater learning engagement and perceived achievement.

Management and control

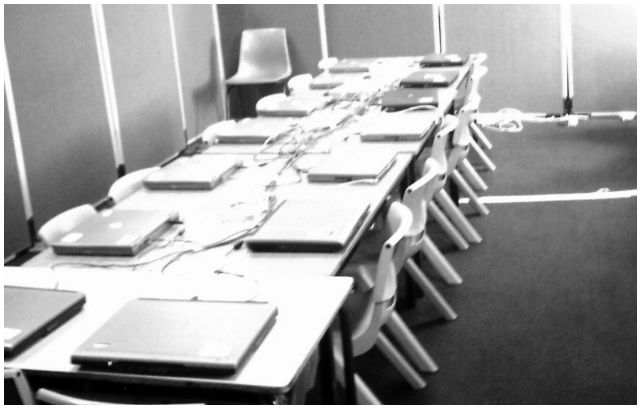
In no school was it possible for the teacher to directly view all student computer screens from a single vantage point. At Oceanview every pupil in the class simultaneously used screen capture technology (SynchronEyes) to add a thumbnail image of their screen to the set projected on the interactive whiteboard (see Figure 1). In Jumbuk the management software AB Tutor[11] was used to make pupil screens visible on the teacher's computer, or to freeze/share them. Standard internet filtering was used in all schools. Given the dynamic nature of classroom furniture arrangements, similar management approaches would seem advisable in any other primary school contemplating adopting a 1:1 computer strategy.

9 http://www.origoeducation.com/go-maths/

10 http://www.nap.edu.au/

11 http://www.abtutorcontrol.com/html/Tutor_Control.html

Fig 2: River Fields - The laptop lab before classes start. There are 14 computers on the central table, with others to the right and about 6 more behind and around the corner.



Funding and pupil ownership

These schools were able to fund the laptops and other infrastructure through a mixture of sources. There was no correlation between the extent of parental cost sharing and the degree of ownership delegated to their son or daughter (see Table 3). Rarely was the authority to install new software allocated to the user – schools are very sensitive to the potential harm malware could cause to a school server or network. Three of the six schools allowed students to personalise the computers. For example, within a day after being handed out (100% parent attendance – never seen before), pupils at Duxton had activated the voice recognition feature of Vista to allow them to start an internet browser by spoken command. Others had stuck transparent material over their screens to keep them scratch- and fingerprint-free, or stuck skins over the back of their screens, to make their netbooks colourful, distinctive and attractive. Other research has found that 'ownership' is a critical aspect of successful learning with 1:1 technology (Fluck & Burston, 2009).

Table 3: Resourcing and ownership

School	Equipment	Cost to parents	Student use at home
Jumbuk State School	Dell Latitude E6400 14", 160Gb HDD, extended battery	$1500	unlimited
Oceanview Public School	15" laptop with 1-2Gb RAM	$965	None
Duxton Primary	Lenovo S9 netbook (running Windows Vista and Office 2007) with 1Gb of RAM.	$52 per year	unlimited
River Fields Public School	Mostly 15" laptops at end of life from a commercial business	nil	None
Cadillac Fountains State School	Dell Latitude 5500 - 15"	nil	None
Arboreal Way Primary School	Acer Aspire One netbook 10.1" screen 1.66GHz Atom processor, 1Gb RAM, 160Gb HDD	nil	unlimited

Problems with networking

Schools present particular challenges to wireless networking installations. Firstly, they have a very high density of computers – thirty in a single room is not unusual. This combines with another technical difficulty: there is another room either side with a similar number of transceivers, creating channel congestion. Finally, the communication load is very rarely spread over the day – everyone begins class at the same time, causing a log-on peak demand for services; and frequently at the end of each lesson each student saves their work to the server and/or creates a large amount of traffic by sending their document to the printer.

It is therefore no surprise that at Oceanview the wireless network adapters sufficient in 2007 were unable to handle additional loading in subsequent years, and were replaced by neat CAT 5 cable to pupil desks. Similarly at Cadillac Fountains, laptops borrowed from an adjoining class were connected using CAT 5 cables into sub-floor recesses also containing power sockets. Banksmeadow's lab-based laptops were fully wired for networking. Wireless connectivity at Arboreal Way was easy for the small number of netbooks, with accompanying desktop computers using wired networking. At Jumbuk the 3Com wireless access points were mostly sufficient to give high speed links (but some channel assignments might relieve congestion), and regional support appeared to have ensured Duxton had very adequate wireless networking for the three classes using netbooks in close proximity. Duxton was therefore the only school where wireless networking was fully effective and reliable: giving some cause for concern to potential emulators of the 1:1 strategy. This aspect of implementation requires considerable planning and probably significant investment of resources to work well in the classroom environment.

CONCLUSION

This report has provided case studies of six Australian government primary schools that adopted 1:1 laptop computers. The adoption was entirely separate from the government's Digital Education Revolution for students in Years 9 to 12. Laptops for older pupils may align with university learning which has become increasingly technology-based, but does leave a lack of emphasis on computational thinking in the early years and infrastructure development in primary schools. This combines with a general uncertainty about the role of ICT in schooling – whether it is merely a general capability supporting a traditional curriculum, or a separate subject in its own right. At the time of writing ICT is projected to be combined with Design and Technology in Phase 3 of the development of the national curriculum (Australian Curriculum, Assessment and Reporting Authority, 2011). Policy documents highlight the transformative potential of ICT in schooling (*Australian Information and Communications Technology in Education Committee*, 2011, p. 4), but practical implementation of these aspirations will continue to be difficult if primary schooling continues to face the tensions highlighted in this report.

These six case study schools revealed three interlocked tensions: diversity of implementation and expectation; conflicted views about supporting or transforming the curriculum; and particular difficulties with wireless networking.

The diversity of funding, ownership, activity and criteria for success is useful for exploring dimensions of an innovation, but was salutary for other Australian primary schools. Most concerning was the huge disparity between the parental financial contribution for resourcing these laptops, and the lack of alignment with pupil ownership/personalisation. Schools which allowed pupils to take the computer home might expect increased time on task, a factor contributing to learning achievement. A diversity of teaching strategies was observed, with some elements of flexible delivery and pupil-centred learning using online learning materials emerging. However, the impact of laptops is difficult to measure. Other states such as Maine in the USA have found little impact when assessed by the standards of the conventional curriculum (Weston, 2010, p. 6). Staff in the case study schools similarly had conflicted views about the contributions laptops might make to improving pupil achievement as measured by the NAPLAN assessments. Perhaps new metrics of learning are needed to assess pupil achievement in the new medium and with the new ICT tools? This echoes a policy disconnect between strategy and operational practice in New Zealand (Ward & Parr, 2011, p. 326).

To resolve conflicted views about adopting such new metrics, we need careful thinking about the transformation of schooling through ICT: whether it be new curriculum content supplementing or replacing the old; or making topics approachable at far younger ages than previously (Fluck, Ranmuthugala, Chin & Penesis, 2011). Some activities in the case study schools supported the conventional curriculum and others went beyond it. Schools had made an equity commitment to parents and the community that pupils in laptop classes would address exactly the same curriculum mandated across the government school sector and in non-laptop classes. This gave rise to tensions, especially during the initial weeks of the year when laptop pupils had a whole range of operational skills to acquire (such as touch typing) so they fell behind their same-age counterparts in other areas. This lag was quickly ameliorated once the ICT skillset had been mastered, and pupils went on to subsequently achieve at higher levels.

Finally, there was a particular difficulty with wireless networking. Often supplemented with wired networking, this indicated inadequate knowledge about wireless networking suitable for school operational needs. Low lag wireless networking within the classroom is essential for laptops to be used effectively as furniture is re-arranged to accommodate different teaching strategies and students are assigned to varieties of learning groups.

Australian pathfinder schools were amongst the first to adopt 1:1 laptops, but the country has failed to scale this more widely across the primary sector, despite some useful state/sector initiatives and strategic encouragement. ICT is striving to find a place in the emerging national curriculum (Australian

Council for Computers in Education, 2011). This lack of focus on what ICT is about, what learnings it can enable and the degree to which it merely supports (sometimes inappropriately) pre-existing subjects could conceivably explain where we have lost ground. In short, Australian government primary schools are bravely investing time, energy and resources into exploring portable computing. We have a world-lead to re-capture!

BIOGRAPHY

Andrew Fluck *is a senior lecturer in information technology at the Faculty of Education, University of Tasmania. He has developed an eExams system by which students use their own computers for summative assessments, as a way of enabling a digital curriculum.*

REFERENCES

Australian Information and Communications Technology in Education Committee [AICTEC] (2011) *Submission prepared in response to the House of Representatives Standing Committee on Infrastructure and Communications inquiry into the National Broadband Network*. Retrieved June 9, 2011 from http://www.aph.gov.au/house/committee/ic/NBN/subs/Sub124.pdf

Australian Council for Computers in Education (2011) *ACCE Position Paper on ICT in the Australian Curriculum*. Retrieved June 7, 2011 from http://acce.edu.au/sites/acce.edu.au/files/ACCE_Position_final.pdf

Australian Curriculum, Assessment and Reporting Authority (2011) *Curriculum development process for the Australian Curriculum: Technologies (Information and Communication Technology and Design and Technology).* Retrieved 31/05/2011 from http://www.acara.edu.au/curriculum/technologies.html

Education Queensland (2002) *A guide to productive pedagogies: Classroom reflection manual.* Curriculum Implementation Unit: Brisbane. Retrieved May 24, 2010 from http://education.qld.gov.au/public_media/reports/curriculum-framework/productive-pedagogies/pdfs/prodped.pdf

Fluck, A. and Burston, M. (2009) Towards Transformation: AlwaysOn Students and Health Education. Paper presented at the *World Conference on Computers in Education,* 27-31 July, Bento Goncalves, Brazil. Retrieved May 25, 2010 from http://www.wcce2009.org/proceedings/papers/WCCE2009_pap51.pdf on 25May10 .

Fluck, A., Ranmuthugala, D., Chin, C.K.H. and Penesis, I. (2011) Calculus in elementary school: an example of ICT-based curriculum transformation. In *Proceedings of Society for Information Technology & Teacher Education International Conference 2011* (pp. 3203-3210). Chesapeake, VA: AACE. Retrieved from http://www.editlib.org/p/36810.

Johnstone, B. (2003) *Never Mind the Laptops: Kids, Computers, and the Transformation of Learning.* Bloomington, IN, USA: iUniverse.

Kraemer, K. L., Dedrick, J. and Sharma, P. (2009) One Laptop Per Child: Vision vs. Reality. *Communications of the ACM,* 52(6), 66-73.

Rudd, K., Smith, S. & Conroy, S. (2007) *A digital education revolution.* Retrieved 31/12/2007 from http://www.alp.org.au/download/now/labors_digital_education_revolution_campaign_launch.pdf

Stager, G. S. (1998). Laptops and learning: Can laptop computers put the "C" (for constructivism) in learning? *Curriculum Administrator.* Retrieved May 24, 2010 from http://www.stager.org/articles/CAlaptoparticle.html

Ward, L. and Parr, J.M. (2011) Digitalising our schools: Clarity and coherence in policy. *Australasian Journal of Educational Technology* 27(2)326-342.

Weston, M.E. & Bain, A. (2010). The End of Techno-Critique: The Naked Truth about 1:1 Laptop Initiatives and Educational Change. *Journal of Technology, Learning, and Assessment,* 9(6). Retrieved June 7, 2011 from http://www.jtla.org

World Bank (2008) *List of countries by GDP (nominal) per capita.* (2010, May 19). In Wikipedia, The Free Encyclopedia. Retrieved 01:14, May 25, 2010, from http://en.wikipedia.org/w/index.php?title=List_of_countries_by_GDP_(nominal)_per_capita&oldid=363098878 World Development Indicators database, Accessed on February 4, 2010.