Premier's Logitech New and Emerging Technologies Scholarship

A comparative study of programming, teaching and teacher training

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The Focus

A study of curricula, pedagogy, emerging technologies and teacher training in Information and Communication Technology (ICT), computing science and creative digital courses in secondary schools in Singapore, the United Kingdom, Canada and the United States of America.

The Rationale

This is a period of extensive and rapid change in hardware and software technologies. As a consequence it is also one of experimentation and innovation in technology education. Computing has forever changed the educational landscape and the set of skills and experiences our students require.

The availability of powerful and innovative software tools offers our students unparalleled opportunities for self-expression while confronting curriculum developers, teachers and teacher trainers with major challenges.

*‘As a foundation for further learning and adult life the curriculum will include practical knowledge and skills development in areas such as ICT and design and technology, which are central to Australia’s skilled economy and provide crucial pathways to post-school success.*

The **Melbourne Declaration for the National Curriculum**, 2008: 13.

Introduction

Schools throughout the world are engaged in considerable debate in determining not only the content of ICT education but also its curricula. What should be its content and at what level? What tools should be used? Should specialist stand-alone subjects be included? Should these be mandated as core or offered as electives?

A major [Royal Society report](https://royalsociety.org/~/media/education/computing-in-schools/2012-01-12-computing-in-schools.pdf) found that teachers, academics and the computer science industry were in agreement that British schools had "lost their way" in teaching computing and that “schools are failing to expose pupils to the interest, excitement and creativity that even a modest mastery of the subject offers". Professor Steve Furber, who led this study into computing in United Kingdom schools, observed in this report that we have succeeded in making people comfortable with using technology but at the expense of the deeper understanding of computing.

Even the term ICT is inadequate. *Information and Communication Technology* suggests a soul-less exchange of data, giving no hint of the highly creative activities possible using contemporary technologies. Perhaps *Information and Creative Technology* would be a more suitable term.

The emergence of tablet computers (still in their formative generations), the rise of specialised apps, the ubiquity of social networking and the increasing sophistication of software are all impossible to ignore if we wish to be responsive to the 21st century needs of our students.

Finally, we need to ask how the skills of the large body of existing teachers can be advanced and how new teachers can be found.

Brief outline of the research visits

**Singapore**

**Innova Junior Secondary College**

Innova Junior Secondary College[[1]](#footnote-1), established in 2005, has over 1000 year 11, 12 students in their final year prior to university or polytechnic transition. The College is the only endorsed Centre of Excellence (COE) for New Media in Singapore with a mission to become a national flagship of new media teaching. It is a well-resourced school, recommended to me by Adobe Asia Pacific Education as having particular strengths in emerging media.

Innova shares with NSW the challenge of insufficient suitably trained computing teachers, leading to their recent cancellation of one popular computing course.

**Ngee Ann Polytechnic**

At [Ngee Ann Polytechnic](http://www.np.edu.sg) (NP) Teaching & Learning Centre, a selection of interactive digital media was presented accompanied by a tour of Studio27, a student media hub set up as a cross-curriculum general resource and extensive visits to other facilities.

**United Kingdom**

IT teachers in UK schools were still assimilating the announcement made January 2012, by Michael Gove, UK Education Secretary, that the ICT national curriculum would be abolished. In each school visited, ICT teachers were hastily devising replacement courses.

**The Marlborough School**

Media studies and ICT classes were offered at the [Marlborough School](https://www.marlborough.oxon.sch.uk/), a mixed comprehensive school for boys and girls aged 11 to 18 located in Oxfordshire, however no computer science or senior digital media courses were on offer.

**Wood Green School**

Richard Young is Director of ICT and Business Education at [Wood Green School](https://wgswitney.org.uk/) with six dedicated ICT rooms. As a Microsoft Partnership School, his students have access to Microsoft software and web space access from school or home. Young records audio files to enable students to revisit instruction later.

Although project work exists, it is shackled to the weight of onerous marking requirements where multiple outcomes must be identified and cross-referenced. The burden results in teachers setting narrower tasks which match specific outcomes.

One child’s overheard comment to his father resonated with Young: “Dad, isn't it great that you don't need to program computers anymore? They do it themselves!” – arguably the inevitable outcome for students educated as naive and passive consumers of IT.

**Bletchley Park and The National Museum of Computing**

I was fortunate to visit Bletchley Park, ground-breaking centre for WW2 code breaking and its associated institution, the National Museum of Computing. School visits are encouraged and workshops offer students a humbling perspective on the genesis and development of computing.

**Canada**

**Johnston Heights Secondary School, Surrey, British Columbia.**

Johnston Heights established a proposal to use iPads in teaching and learning and its success is now spreading to other Surrey District schools. The school is now seeking to establish a Bring Your Own Device (BYOD) approach.

**Cindrich Elementary, British Columbia**

Numbered iPads are used for project work. A charging cabinet did not sync these adequately so management was found to be time consuming.

Productions were collections of pictures, sometimes manipulated with a sound track. Here the iPad outcome was no different from PowerPoint and less interactive, although clearly more engaging to students.

**United States**

**Microsoft, Redmond, Washington**

As a participant in the Australian Council for Computers in Education (ACCE) tour I attended at Microsoft a presentation of their Partners in Learning Program, in which Microsoft has invested $150 million. The program’s framework is designed for school innovation and renewal.

**Inglewood Junior High, Sammamish**

Every student has a NetBook and permission to take them home. When questioned, students said the hardest aspects were weight, slowness and the limitations on drawing.

**Google**

A day workshop at Google’s campus centred around collaborative tools as part of Google+. Proving useful to many teachers is Google Drive[[2]](#footnote-2), allowing documents to be authored collaboratively, one of its many interactive features. This suite suggests a looming roadblock for Microsoft Office offering features easily leveraged in project-based, collaborative environments.

**Computer History Museum**

Situated in Mountain View, California, this [museum](http://www.computerhistory.org/) has a different perspective to that of Bletchley’s. Here the emphasis is on displaying computer hardware and its iterations. The Museum easily fulfils its claim to hold the most significant and varied collection of computing hardware, software, documents and ephemera in the world.

Its online site offers a humbling experience for today’s ‘digital natives’. Babbage’s difference engine can be seen functioning in the museum - a mesmerising and beautiful brass artwork 17 years in the making. The site is worth visiting for this one item alone.

**Apple, Cisco, Oracle**

A visit was also made to Apple in Cupertino and extended hosted visits to Cisco and Oracle. At Cisco, Jabber video conferencing software was demonstrated. The setup was comparable to the ‘connected classrooms’ installed in NSW schools.

**Pride Academy, Santee, California**

[Pride Academy](http://www.santeesd.net/Domain/538), an elementary school, has a Bring Your Own Device (BYOD) policy. IT integration is strong and IT tools well leveraged. Creative group project work included highly creative class debates, one where years 3 and 4 were required to argue “who should be the President of the periodic table?”, designed to tie in with US national elections, with each team trying to outdo each other in argument, and inadvertently learning chemistry while electioneering!

**El Cajon Valley High School**

[El Cajon Valley High School](http://braves.guhsd.net/) described itself as having many of the characteristics of an international school, with a significant transient population of refugees.

El Cajon had tried a BYOD approach but found it unsuccessful. The school saw significant advantages in iPads: they were interactive, encouraged relevant new skills, started immediately, their screens were easily seen by teachers, and they served as document cameras and when using wireless connections were sharable with a class.

One teacher commented: “We have to teach students now how to communicate online not just in person.”

**San Diego State University**

My visit was hosted by Bernie Dodge PhD, Professor of Educational Technology and the creator of the [Webquest](http://webquest.org/) approach.

Dodge bemoaned the fact that Masters in Technology often have no programming experience and that the requirement to study technology has been abandoned in teacher training.

He argued ‘No child left behind’ meant that education was now about passing a test. Programming a computer was not on the test and thus not taught, a subject he believes is vital if we wish to produce engineers. Dodge says teachers should emphasise the higher goals such as: Decide, Design, Create, Analyse and Predict.

**ISTE Conference 2012, San Diego**

In San Diego, along with 18,000 other IT educators, I attended the four day 2012 [International Society for Technology in Education](https://www.iste.org/) (ISTE) Conference. Among the hundreds of workshops, the dominant theme was the integration of ICT across the curriculum.

US, Canadian and UK teachers were preoccupied in finding escape routes from mundane lessons and the imperative to teach to standardised tests. In these countries, project-based learning, collaborative learning and group work were innovative concepts about which they were eager to learn. It was widely recognised among the delegates that Australian schools have engaged with these themes for years.

A great deal was made of these tools being instrumental in ‘flipping the classroom’, an overused expression which I learned to distrust. In practice this signified no more than the watching of teacher-made video lectures at home in preparation for work in class, thus sadly betraying a dominant paradigm in many US classrooms.

A number of keynote sessions resonated strongly: Sir Ken Robinson emphasised the accelerated nature of technology and the importance of personalising education, Dr. Willie Smits told how a group of students and teachers around the world began a collaborative online mapping project, halting an occurrence of deforestation - a dynamic example of real-world online project-based learning and Gavin Dykes detailed the English experience.

Emerging technologies and educational needs

Although there are timeless life skills and knowledge important for success in any age, what one needed to be a successful 19th century agrarian citizen differs dramatically from the expertise needed to be a successful 21st century one.

In the world of education, little has changed. Classrooms across the world look much as they always have, a single teacher in front of a board, imparting knowledge to students seated at rows of desks. In terms of technology, if the past is any indication, education has either caught the current wave too late and finally having caught it, made second-rate copies. (see Table below)

|  |  |  |
| --- | --- | --- |
| **Decade** | **Dominant tech trend** | **Dominant educational media trend** |
| 1950’s | print media | textbooks, film |
| 1960’s | television | textbooks, television, film |
| 1970’s | global communication | textbooks, television |
| 1980’s | video | textbooks, video |
| 1990’s | desktop computer | labs of desktop computers, textbooks, video |
| 2000’s | Internet and mobile phones | labs of desktop computers, textbooks, data projectors, IWBs |
| 2010’s | Interactive mobile devices  | personal laptops, tablets, data projectors |

*Table 1: Society’s and education’s dominant paradigms compared by decade*

Researcher Larry Johnson[[3]](#footnote-3) speaking at an ISTE workshop, identified these as the major emerging technologies:

* + Adoption within one year: mobiles and apps, tablets
	+ Adoption within two to three years: game-based learning, personal learning environments (PLEs)
	+ Adoption within four to five years: augmented reality (AR) and natural user interfaces.

To these I would add the proliferation and increasing sophistication of software applications.

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When considered in the educational realm, I believe the following interconnected challenges become apparent:

* *Electronic books:* Now firmly established in the consumer sector, electronic books and its devolving tools of creation are demonstrating capabilities that challenge the very definition of reading and of [textbooks](http://www.apple.com/ibooks-author/).
* *Mobile computing:* Internet capable [mobile](https://library.educause.edu/-/media/files/library/2011/2/hr2011-pdf.pdf) devices will not only outnumber humans by the end of 2012, they will outnumber computers.
* *Personal learning environments (PLEs):* students will want to utilise their own devices, digital environments, social networks, apps and tools presenting challenges for teachers and network administrators alike.
* *Open content:* [Open content](http://ocw.mit.edu/about/media-coverage/press-releases/ala-best-reference-sites-2012/) will increase in acceptance in the next year as certain sites have now reached critical mass.
* *Simple augmented reality:* A workshop demonstrated a San Diego Zoo excursion where AR geo-triggered at certain locations and initiated informative animations for students. The [Powerhouse Museum](https://maas.museum/powerhouse-museum-website/) in Sydney allows visitors to use mobile phones to see Sydney as it appeared one hundred years ago. AR is set to grow.
* *Game-based learning:* [Game-based learning](https://library.educause.edu/-/media/files/library/2010/1/csd5810-pdf.pdf) provides opportunities for immersive experiences across a wide range of subject disciplines, promotes higher order thinking and encourages problem solving.
* *Visual data analysis:* Students will use authoring tools to perform data analysis and visualise complex animated statistical relationships,[[4]](#footnote-4) a vital skill in the light of moves to link numeric data in the same manner as the Internet links words.[[5]](#footnote-5)
* *Proliferation and sophistication of apps:* Creative project-based learning invites the use of a wider range of apps: subject-specific and creative “learner-centred” software rather than only generic.[[6]](#footnote-6)

A way forward

How then should we proceed? We can learn a lot by comparing school lessons to the lives young people lead outside school. In increasing numbers, they browse the web, download videos and music, maintain and cultivate friendships using Facebook, upload YouTube videos, watch multi-channel digital TV, blog, tweet and read online – concurrently and on multiple devices.

In this interconnected world, young people have an expectation that experiences and services will be freely available, mobile, reliable, ubiquitous and configured to their needs and preferences. We all want to be able to work, learn, and study wherever and whenever we want. Throughout the ISTE conference at workshops and keynote addresses, members of our group micro-blogged using Twitter, asking questions, commenting on content and seeking reactions. At Abilene Christian University, attendees at a performance of Othello were asked not to turn their phones off during the performance, but instead use them to receive messages from actors clarifying Shakespearean language, sharing scene summaries, and interacting through a live blog.

Sugata Mitra, of the “[Hole in the wall project](http://www.ted.com/talks/sugata_mitra_shows_how_kids_teach_themselves.html)”, says we need: “... an educational technology and pedagogy that is digital, automatic, fault-tolerant, minimally invasive, connected and self-organized...I think it's time that the educationists made their own specs.”

I believe we can now say what these specs are.

***Multiple mobile devices***

Teaching using multiple devices has proven more manageable in primary schools but US secondary schools were trialling class sets of mobile touch-screen tablets. None had results to validate teacher perceptions of their efficacy. However, a thorough trial of iPads was conducted this year in Sydney by [Dr Kristy Goodwin](https://fad.teluq.ca/teluqDownload.php?file=2013/11/iPad_Evaluation_Sydney_Region_v2.pdf) on behalf of the NSW Curriculum and Learning Innovation Centre. It reported:

“One of the chief benefits of mobile devices is that they enable learning anywhere, anytime...in deploying mobile devices, the teacher is no longer at the centre of the learning process and the instruction can transcend the school day.”

As apps move to the cloud, acceptance of the use of multiple devices in non-specialist courses will inevitably prevail. Many students are discovering this independently.

***Collaborative computing in the cloud***

A challenge for education in the 21st century is to create an approach that at least matches young people's expectations of technology, and not arrive too late. It must also address educational needs such as collaboration and prepare students for future employment in a world of ubiquitous media.

Google Drive combines a synced cloud-based suite of applications and acts as a collaborative tool, ideal for presentation, formative assessment and constructivist approaches to teaching.

***Creation, not only consumption***

The time has arrived for a digital media education which emphasises creation and not only consumption. We have the technological tools and a digitally literate generation who need to express themselves and deserve to be afforded creative control.

This past decade the proliferation of student video competitions were just the beginning. We are now at the start of even more significant revolution as ebooks acquire a heightened level of interactivity, incorporating immersive and multi-modal media and permanent connectivity.

Apple’s *iBook Author* app allows students to become content creators of their own interactive online publications, far more empowering than traditional eportfolios and heralding huge opportunities for teachers reminiscent of hypermedia products of the 1980’s, only vastly more sophisticated.

The blossoming of educational gaming provides opportunities for students, using object-oriented modular environments or dedicated coding, to build games from the ground up using [programmatic methods](https://scratch.mit.edu/).

The emerging technology of 3D printing can inspire students to learn engineering, using 3D design software to print [3D models](https://www.makerbot.com/) - even making them articulated!

***Dedicated courses***

I have listened to a group of my year 7 and 8 NSW students in eager conversation with a visiting senior educational official about their after school programming club and our school’s success in Sydney University’s online [Programming Challenge](http://challenge.ncss.edu.au/) but in NSW these students must wait five years to study computer science. Not all students want to code, but those who do should be encouraged and their skills are needed.

NSW is further ahead of the game than any other educational jurisdiction I observed, but is not without challenges. The NSW 9-10 Information and Software Technology elective course - rich in authentic project-based real-world IT - has seen a notable a drop in enrolments, a drop it does not deserve. Schools lack trained and experienced teachers to do the course justice and as students are not easily fooled, they vote with their feet.

The current parlous numbers of pre-service computer teachers is greatly disturbing. I interpret this as being due to a combination of four factors:

* + In the absence of dedicated Computing Departments in schools there is an unholy marriage of disciplines that forms a TAS (Technology and Applied Studies) faculty where teachers typically emerge from a trade oriented background (timber/metal/hospitality/textiles) rather than a maths/computing science/creative digital media one
	+ The greater financial rewards to be found outside teaching
	+ The absence of an acceptable career promotion career path for teachers with a computing major
	+ The uninformed assumption heard often from administrators, teachers of other disciplines, and members of the public that students are all 'digital natives' now and no longer require specialised computing subjects.

We need to offer dedicated computing courses much earlier, taught by specialist teachers at a much higher skill level. We need skilled teachers of digital media whose attitude must be that of Paula Landry, “I teach the business of media, but what I am doing is preparing the next generation of media innovators.”[[7]](#footnote-7)

Exposing teachers to industry standard practice and providing opportunities to update skills via university and vocational courses are vital.

Conclusions

“Life is a multimedia event, and the meanings that we secure from life are not simply contained in text; they yield their content through a wide variety of forms” (Eisner, 2002, p. 154). Digital software tools are a catalyst for creativity. They are compelling, powerful, expressive, forgiving, portable, accessible, desirable, lasting… and more. Sir Ken Robinson, who opened the 2012 ISTE Conference made these observations in [his celebrated TED talk of 2006](http://www.ted.com/talks/ken_robinson_says_schools_kill_creativity.html) which I quote, despite their familiarity:

“Children starting school this year will be retiring in 2065. Nobody has a clue … what the world will even look like in five years' time. And yet we're meant to be educating them for it...
...my contention is that creativity now is as important in education as literacy, and we should treat it with the same status.”

In 2010 Robinson ended a [second TED talk](http://www.ted.com/talks/sir_ken_robinson_bring_on_the_revolution.html) with a [quote from W B Yeats](http://www.elise.com/q/quotes/yeats.htm):

"I have spread my dreams under your feet;

Tread softly because you tread on my dreams.”

and added: “And every day, everywhere, our children spread their dreams beneath our feet. And we should tread softly.”

But we can do far more than tread softly. We can cultivate these dreams. At the present we deprive talented and creative students of the tools they need to express themselves and we fail to expose teachers to the experiences they need to nurture “digital natives”. We may not know what 2065 will look like, but we know that those of us whose creativity was encouraged were better equipped to adapt as our futures were revealed.

What then are the essential components if we are not to miss the opportunities emerging technologies offer?

The first is to set goals and the bar high enough in well designed curricula. The new national curriculum offers this opportunity.

The second is to train teachers to move beyond mere instruction to becoming technology mentors, to enjoy technology for its power to liberate creativity, build self-esteem and empower collaboration.

The third is to provide the technological tools needed: software, hardware, bandwidth and support.

One thing is certain: teaching to a national testing regime or merely using technology or producing passive consumers of it, destroys the sense of wonder, enthusiasm and creativity in our students. And it destroys ours as their teachers.

Have we forgotten what Socrates taught us? Our students must travel their own road of learning but most would wish for a companion, a knowledgeable mentor who respects them as fellow traveller.

They do not ask for a tour guide, who selects the route in advance, Google maps-like. They need one, who endowed with the wisdom of many past journeys, allows them to explore the side roads for a time before suggesting the next question, helps out when needed and recognises in their fellow traveller’s eyes the joy of discovery around each new corner.

Such a teacher will make discoveries of their own.

1. Ms Li Wee, Head of IT and Pearline Ong, Media Centre Manager [↑](#footnote-ref-1)
2. previously Google docs [↑](#footnote-ref-2)
3. Chief Executive Officer of the New Media Consortium (of universities, colleges, museums, research centres, and technology companies). [See The 2012 Horizon Report: K-12](https://library.educause.edu/resources/2012/2/2012-horizon-report) [↑](#footnote-ref-3)
4. Hans Rosling: [No more boring data](https://www.youtube.com/watch?v=hVimVzgtD6w&feature=relmfu) and [GapMinder](https://www.gapminder.org/) [↑](#footnote-ref-4)
5. Tim Berners-Lee: [The next Web of open, linked data](http://www.youtube.com/watch?v=OM6XIICm_qo) [↑](#footnote-ref-5)
6. V.N. Morphew “A constructivist approach to NETS\_T” ISTE 2012 ISBN 978 1 56484 313 5 [↑](#footnote-ref-6)
7. New York subway advertisement, June 2012, Paula Landry, Professor of Management, Metropolitan College of New York [↑](#footnote-ref-7)