Premier’s Special Education Scholarships

Universally designed expert learners

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Introduction

"Poorly designed systems can create new barriers to participation in society, but good universal design can empower everyone to participate as equals." Professor Norman Coombs

The first decade of this century has been marked by exponential growth in creation of new fields of information (such as cognitive neuroscience or [epigenetics](http://en.wikipedia.org/wiki/Epigenetics)), as well as powerful and dynamic ways to communicate and collaborate using web based services (banking), smart phones (iPhone) and mobile learning devices (iPad). These broad changes in our understanding of the world and the technologies we use to communicate, collaborate and create with have transformed society and, as a microcosm of society, the classroom. Modern classrooms as predicted by Marshall McLuhan (1967) are now ‘ones without walls’. 21st Century classrooms are learning environments where digital technologies are seamlessly integrated with face-to-face classroom methods to form a cohesive instructional approach that enables learning to occur anywhere, anytime.

In this ever-changing world there is an imperative for everyone to be a lifelong learner from both a personal and professional perspective. As Gerjuoy (1971) stated ‘the illiterate of the 21st century will not be those who cannot read and write, but those who cannot learn, unlearn, and relearn.’ As such, teachers must fluently model to students how to work and learn in a connected global digital society if the students are to become lifelong learners. Learning how to teach effectively in a digital world involves understanding the evidence-based practices underpinning how students learn in a digital world [Mayer (2001, 2009) and Rose, Meyer, and Hitchcock (2005)].

Despite the wide body of evidence and the fact that personal computers have been available for over 30 years there still exists significant variation in teachers’ knowledge and capacity around successful integration of ICT into their everyday practice. Given this variation and the pace of technological change it reinforces the view that when it comes to technology, teachers need as much scaffolding as students. This is especially so since a lack of teacher knowledge leads to misunderstanding and mistakes, which consequently lead to the creation of poorly designed and, thus, disabling learning environments.

Coombs’ comment encapsulates the core of this study project and underpins the driving question of this study, which is: how can we improve the design of modern learning environments to enable all students to become lifelong learners? To answer this we need to work backwards and critically examine several focus questions:

* + What are the characteristics of an expert learner?
  + What are key instructional design strategies that educators can implement to support all students to become expert learners?
  + What can teachers learn from industry about universal design as a means to improve student outcomes?

To assist in answering these questions I identified and visited the following leaders in their respective fields. These visits were supplemented with academic journals and texts:

* + - 1. Apple Inc (Cupertino). Apple are leaders in creating highly intuitive hardware and software designs that focus on the user experience. As Sir Jonathon Ive (Apple’s Senior Vice President of Industrial Design), mentioned in a recent media interview, ‘the designs are based upon a humble simplicity as a design maxim, where the final product and the remarkable technological feats retreat to the background and create the stage for the user experience as a whole — where the happy user ultimately doesn’t appreciate the design itself` but instead, senses the great care put into it and derives an emotional connection on a level beyond the technical.’
      2. Center for Applied Special Technology ([CAST](http://www.cast.org/)) to undertake a two-week research internship on how a Universal Design for Learning (UDL) framework can be applied in a distance education setting. CAST is the pre-eminent educational research and development organisation that works to expand learning opportunities for all individuals, especially those with disabilities, through Universal Design for Learning.

What do expert learners look like?

‘To be literate means to have knowledge or competence. To be fluent is something a little more; it is to demonstrate mastery and to do so unconsciously and smoothly.’ - 21st Century Fluency Project

**Learner Characteristics**

Ensuring that *all* students develop the skills and attitudes to become expert learners is a cornerstone of education. This is reinforced by the Australian Curriculum, Assessment and Reporting Authority (ACARA) which calls for all students to develop ‘a comprehensive set of knowledge, skills and dispositions or general capabilities that will assist them to live and work successfully in the twenty-first century.’

A critical examination of these ‘skills and dispositions’ leads one to recognise that expert learners are more than just successful learners. Expert learners possess specific skills and attitudes that have enabled them to progress as well as a capacity for sustained learning. In Fig 1, CAST has identified three broad characteristics (and their constitute elements) of an expert learner.

| Fig 1: Characteristics of expert learners - Excerpt from Universal Design for Learning (UDL) Guidelines: Full-Text Representation |
| --- |
| 1. Resourceful, knowledgeable learners: Expert learners bring considerable prior knowledge to new learning, and activate that prior knowledge to identify, organise, prioritise, and assimilate new information; they recognise the tools and resources that would help them find, structure, and remember new information; they know how to transform new information into meaningful and useable knowledge. 2. Strategic, goal-directed learners: Expert learners formulate plans for learning; they devise effective strategies and tactics to optimise learning; they organise resources and tools to facilitate learning; they monitor their progress; they recognise their own strengths and weaknesses as learners; they abandon plans and strategies that are ineffective. 3. Purposeful, motivated learners: Expert learners are eager for new learning and are motivated by the mastery of learning itself; they are goal-directed in their learning; they know how to set challenging learning goals for themselves, and know how to sustain the effort and resilience that reaching those goals will require; they can monitor and regulate emotional reactions that would be impediments or distractions to their successful learning. |

In classifying and articulating these characteristics, CAST supports teachers to more easily identify the specific skills and strategies that each child requires. ACARA also recommends the teaching of these general capabilities should be incorporated in ways appropriate to each learning area/subject. Furthermore, it is worth noting that whilst the appropriate use of ICT can support the development of these skills and attitudes, it is not reliant upon possessing the latest ICT.

**Planning for learner variability**

A crucial element of supporting all students to become expert learners is recognising and responding to learner variability as an integral dimension of the curriculum design process. Whilst the Quality Teaching Framework (QTF) recognises that students bring a huge variety of skills, needs, and interests to learning, CAST has studied learner variability at a deeper level from pedagogical, neuro-scientific and cultural perspectives. Firstly, CAST’s research has highlighted that advances in neuroscience have revealed that student differences are as varied and unique as our DNA or fingerprints particularly in the three networks of Recognition, Strategy and Affect. The extent of these differences challenges many presumptions particularly about the mythical ‘average’ student, and teachers who ‘teach to the middle.’

Secondly CAST has developed a curricular framework for supporting learner variability known as the [Universal Design For Learning Guidelines](http://www.udlcenter.org/aboutudl/udlguidelines). CAST has developed the UDL Guidelines as a scientifically valid framework by which teachers could provide flexibility in the ways information is presented, students respond or demonstrate knowledge and skills, and subsequently build and sustain engagement in the learning process. Fig:2 provides a brief summary of the guidelines though a more detailed breakdown of the Guidelines is available on CAST’s [National Center on Universal Design for Learning](http://www.udlcenter.org/aboutudl/udlguidelines) (NCUDL) website. The Guidelines are a rich proactive process that supports all students, in contrast to reactive ways of responding to learner variability. Implementing a UDL framework removes barriers to learning for all students not only those with diverse learning needs in the same way people have benefited from universal design in architecture (e.g.: curb cuts) and product design (e.g.: sensor activated taps). Acknowledging that learner variability is the norm rather than the exception empowers teachers to think more flexibly about how all students will become expert learners.

| Fig 2: Primary Principles of UDL - Excerpt from Universal Design for Learning Guidelines: Full-Text Representation |
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| 1. Provide Multiple Means of Representation as learners differ in the ways that they perceive and comprehend information that is presented to them. This is referred to as the “what” of learning. 2. Provide Multiple Means of Action and Expression as learners differ in the ways that they can navigate a learning environment and express what they know. This is referred to as the “how” of learning. 3. Provide Multiple Means of Engagement as affect represents a crucial element to learning, and learners differ markedly in the ways in which they can be engaged or motivated to learn. This is referred to as the “why” of learning. |

Basham (2011) built upon the CAST research to incorporate Wiggins and McTighe’s (1998) Understanding by Design (UbD) to create the UDL Instructional Process. Basham’s process can be more easily implemented within NSW as many teachers are already familiar with UbD having received training in UbD through state programs such as the NSW Country Areas Program. Fig 3 provides a comparison of Wiggins and McTighe’s UbD framework had a three step planning process Basham’s framework provides a five step process to follow when using the UDL instructional framework.

| Fig 3: Comparison of Curriculum Design Frameworks | |
| --- | --- |
| Understanding by Design (Wiggins and McTighe) | UDL Instructional Process (Basham) |
| * Identify Desired Results - How will the learning goals support and challenge all learners whilst ensuring that the means by which the goal is achieved are not a part of the goal? * Determine Acceptable Evidence - How will students communicate their understanding of the goals? * Plan Learning Experiences and Instruction - How will students perceive and comprehend the learning materials? What are the flexible options for expression and communication? How will you support student planning and strategy development? | * Establish Clear Outcomes - Establish a clear understanding of the goal(s) of the lesson (or unit) and specific learner outcomes’ * Anticipate Learner Variability - Prior to planning the instructional experience teachers should have a clear understanding of the barriers associated with the curriculum as it related to learner variability within their environment. * Measurable Outcomes and Assessment Plan - Prior to planning the instructional experience, establish how learning is going to be measured. * Instructional Experience - Establish the instructional sequence of events. As a minimum plans should include intentional and proactive ways to address the established goals, learner variability, and the assessment plan. Considerations how to support multiple means of Engagement, Representation, Expression & Action. * Reflection and New Understandings = Establish checkpoints for both student and teacher reflection and new understandings |

There is much that all teachers can learn from critically examining how the UDL guidelines can be implemented as part of their curricula design and daily practice. The UDL Guidelines align very closely to the Quality Teaching Framework (QTF). Most importantly they pose questions that prompt teachers to more critically reflect on their curriculum design at a granular level than the QTF. Given the recent release of the Department’s learning and support strategic priorities outlined in ‘Every Student, Every School' it would be prudent to incorporate the CAST research into the professional development programs that will accompany the implementation of ‘Every Student, Every School'. This can be easily and cost effectively achieved as CAST provide a wide range of professional resources including a series of free online [self-paced professional learning modules for teachers](http://www.cast.org/pd/OnlineModules/index.html). At the time of writing, this author has also participated in a series of video conferences with CAST as evidence of extending professional learning opportunities

ICT and learner variability

‘A great user interface follows human interface design principles that are based on the way people (users) think and work, not on the capabilities of the device. A user interface that is unattractive, convoluted, or illogical can make even a great application seem like a chore to use. But a beautiful, intuitive, compelling user interface enhances an application’s functionality and inspires a positive emotional attachment in users.’ Apple previously Human Interface Principles

**Human Interface Guidelines**

As Prof Norman Coombs observed ‘poorly designed systems can create new barriers to participation’ even in 21st Century. Mayer, (2001, 2009), Mayer & Clark (2011) demonstrated that student learning can be enhanced by utilising evidence based multimedia design principles. Similarly Nielsen (1999, 2011) that student learning can be enhanced by utilising based evidence usability research. If good design impacts upon affect (engagement) and usability (productivity) the question that arises is: ‘Do the ICT tools and digital resources teachers utilise in their learning environments have an evidence based design philosophy and, if not, why not?’

Apple’s Human Interface Guidelines which incorporate the Human Interface Principles and User Experience Guidelines are based upon highly multi-disciplinary fields, incorporating aspects of psychology, anthropology, sociology, computer science, graphic design, industrial design and cognitive science. The discipline of education shares common features with most if not all of these disciplines. Given how intuitive Apple’s devices are there is much that the education profession can learn from Apple’s design principles and guidelines and should incorporate into our daily practice. Failure to follow these design rules can disable a learning environment by affecting:

* + How easily learners can accomplish basic tasks the first time they encounter the design,
  + How learners can perform tasks, and
  + How learners can recover from making an error.

Whether it is implementing a learning management system such as Moodle or edmodo, mobile app or a digital resource such as an ePub there are several key design issues teachers need to consider:

* + How well does the appearance of the app/resource integrate with its function?
  + How does the app/resource allow learners to transfer their knowledge and skills from one app/resource to another?
  + How do learners directly manipulate onscreen objects instead of using separate controls to manipulate them?
  + How does the app/resource provide learners with feedback of their actions or progress?
  + What metaphors are used with objects and actions in the app/ resource to anchor learners’ thinking?

Not surprisingly post PC era devices such as the iPad (and the associated apps they run) tightly follow the Human Interface Guidelines being more usable and having a higher utility than the over laden menus and button bars of Microsoft Office and Adobe Photoshop. Intuitive and usable designs result in a significantly lower learning (and implementation) curve that enables the teacher and students to focus on the real learning goals.

**Reading comprehension and screen resolution**

Furthermore, Teachers must also take into consideration how the digital device displays data on screen and the impact on student comprehension. As seen in Fig 4 traditional computer screens display text at comparatively lower resolutions than paper or iPad. These differences influence user behavior and reading efficiency. Nielsen & Pernice’s (2009) eye tracking research demonstrates how the lower resolution of the computer screen combined with how it displays text directly impacts upon legibility and reading efficiency which can lead to reader exhaustion and disengagement.

| Fig 4: Differences between paper and digital devices | | |
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| Criteria | Paper | Digital |
| Display | Printed ink | LCD/LED colour pixels |
| Resolution  (density of dots / pixels of colour) | dpi = dots per square inch   * Newspapers 150 dpi * Laser printer 300 - 600 dpi | ppi = pixels per square inch.  Computers 72 - 96 ppi   * Samsung Galaxy Tab 10.1 - 149 ppi * iPad 2 - 150 ppi * iPad 3 - 264 ppi * iPhone 4 - 326 ppi |
| Reflective | No | Yes |
| Seating position | Back in seat / relaxed. | * Computers: Forward in seat / upright. * Tablets: Back in seat / relaxed. |

Nielsen’s (2010) research highlighted that there is 20 - 25% decrease in reading efficiency on a computer screen compared to paper, with the iPad 2, only 4% behind paper. Nielsen’s latest tests (unpublished) show that there is no difference in reading efficiency on an iPad 3 as compared to paper. This key finding demonstrates that device selection directly impacts upon reading efficiency. Unfortunately many education and ICT leaders limit their calculations of the cost of any given digital device to upfront purchase price and / or support costs. In an education setting the capacity of the device to provide higher levels of reading efficiency and improve learning outcomes is an important variable that requires further transparent investigation and open discussion.

Nielsen (1999, 2009) and Mayer (2001, 2009) have a considerable body of evidence on information design and multimedia learning that can ameliorate the learning deficiencies inherent in lower resolution devices. Part of the solution lies within typography choice, the use of style guidelines on writing for onscreen (low resolution) reading behaviour as well as the use of high quality royalty free rich media such as iTuneU that can be contextualised to support the learning goals. Teachers can easily incorporate their own material provided they have access to reliable, user friendly yet powerful creation tools.

**Inbuilt Universal Access**

Another proactive design decision that teachers and students can make is to consider the inbuilt universal access features within any digital device selected to support students to become expert learners. We must remember that Universal access features equate to a curb cut. For example if a student with a text disability (vision, ESL, low literacy, acquired brain injury etc) wanted to ‘read’ a book on using the iBooks app on an iPad, the device has the inbuilt functionality to convert text to speech. No expensive afterthought adjustments, no complexity issues ensuring additional software integrates with other software, no delays and, most of all, full respect for the individual user. Just as individuals personalize their driving position in their car to improve driver efficiency so should all teachers and students understand the high level of personalization inbuilt within their digital devices, as this can dramatically improve learning efficiency. This is well evidence in Apple’s Special Education section on [their corporate site](http://www.apple.com/education/special-education/).

**UDL in a digital world**

The inbuilt universal design (UD) of any digital device or app is only part of the equation to support learner variation in 21st century learning environments. Building in the learning support (UDL) is the other. There are a several key resources that teachers can begin with.

* + University of Southampton’s [Web2Access](http://www.web2access.org.uk/) program which conducts usability/accessibility checks on web 2 tools
  + CAST’s [Learning Tools](http://www.cast.org/learningtools/index.html) which includes UDL Book Builder and CAST Science Writer
  + National Center on Universal Design for Learning’s [examples and resources](http://www.udlcenter.org/implementation/examples) related to the UDL Guidelines v2.0.
  + Apple’s [iBook Author](http://www.apple.com/au/ibooks-author/) and [iBooks app](http://itunes.apple.com/au/app/ibooks/id364709193?mt=8) which provide the means by which universally designed digital texts can be easily created and published using intuitive consumer level tools. (As part of my scholarship I initiated a critical review of the capacity of these tools in consultation with members of the US National Center on Accessible Instructional Materials and CAST. A series of exemplar templates are currently being produced as part of ongoing collaborations).

Conclusion

Quality teaching is widely recognised as essential to student success (Hattie, 2003. Rowe 2003, NSWDEC, 2012). It is therefore logical to assert that the learning design decisions that teachers make (or don’t make in some cases) in relation to learning goals, methods, materials and assessment can create either enabling or disabling learning environments. As CAST has identified, curricula can be “disabled” in WHO, WHAT and HOW they teach by the decisions teachers make. This can be amplified especially in asynchronous learning environments where materials may only be in one format and the nature and types of scaffolds and feedback are limited.

In its recently released 5 Year Plan (2012 - 2017) and in Every Student, Every School: Learning and Support, NSWDEC has identified as a key priority that ‘quality professional learning for teachers and support staff is vital for ensuring that schools are able to meet the needs of their students.’ This evidence of NSWDEC’s reciprocal accountability is an extremely positive step. It supports teachers to model what it means to be an expert learner whilst up-skilling them in new strategies to better empower students to become expert learners. That said what this research scholarship has strongly reinforced to me is the need for all teachers to have the capacity to proactively design curricula so that all students can be expert learners rather than implementing outdated, costly and reactive ways of responding to learner variability based upon adjustments and after thoughts. As CAST states ‘effective teachers should be creative and resourceful in designing flexible learning environments that address the variability of learners using a range of high-tech and low-tech solutions.’

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