

# Designing inclusive digital learning environments



Greg Alchin, Rural Action Plan Officer, Rural and Distance Education, NSW Department of Education & Communities, overviews fundamental issues, with practical examples, for ensuring all learners have equal access to learning and resources.

*The goal of education in the 21st century is not simply the mastery of content knowledge or use of new technologies. It is the mastery of the learning process. Education should help turn novice learners into expert learners—individuals who want to learn, who know how to learn strategically, and who, in their own highly individual and flexible ways, are well prepared for a lifetime of learning.*

CAST, 2011, p. 4

digital-drug-binaural-beat-man © by [digitalbob8](#)

## Introduction

Every school in Australia has legal obligations and responsibilities under Federal legislation such as the [Disability standards for education](#) (2005) to ensure that all learners with or without a disability are able to participate in learning on the same basis. To ensure that all learners are able to participate in learning on the *same basis* may involve the school taking reasonable steps to ensure that any adjustments required are made within a reasonable time. It is important to note that making these reasonable adjustments should not be confused with differentiating the curriculum.

Since the implementation of the [Disability Discrimination Act](#) (1992) and the [Disability standards for education](#) (2005), the shape of what constitutes a modern classroom has changed and continues to evolve. While there is greater use of ICT in these evolving digital learning environments, the potential of ICT to support a broad range of learner needs, is unrealised in many cases due to low levels of understanding of the technology, how learners process and respond to information when they interact with technology, and what this means from a learning design perspective. In light of these changes and the move towards a national implementation of

the Australian Professional Standards for Teachers, the aim of this article is to examine:

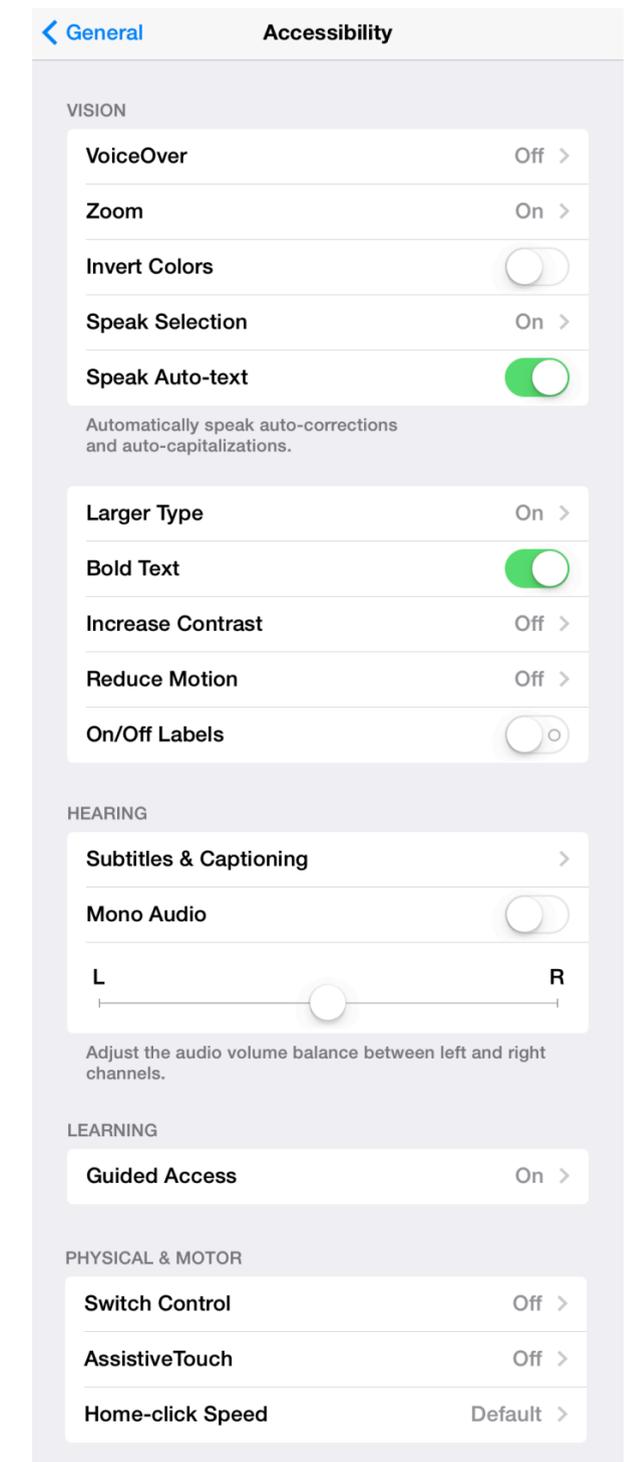
1. What does compliance with legislative requirements look like in a modern school where much of the learning occurs in a blended learning environment or even totally online?
2. How do schools take proactive strategies rather than a reactive response approach to reasonable adjustment?
3. How do proactive strategies model criteria of the Australian Professional Standards for Teachers? In particular, Profession Standards: 2.2, 2.6, 3.3, 3.4, 3.5 and 4.1.

## Permission to do things differently

There are several national initiatives that present educators with the opportunity and permission to design new learning materials and experiences in different ways. These include the introduction of the [Australian Curriculum, Australian professional standards for teachers](#) and the Australian Government's [Web Accessibility National Transition Strategy](#) for adoption and implementation of [Web content accessibility guidelines version 2.0 \(WCAG 2.0\)](#). The key word is design. Design implies prior thinking around the specification of an object and its intended use in a

particular environment by known users to achieve identified goals whilst subject to constraints.

Fundamental to the design of new learning materials and environments which increase engagement and outcomes for all learners is the application of a consistent, research based approach to the design process. Mace's Universal design (UD) is a proactive design strategy that can be implemented to achieve this goal. Universal design is the concept of designing all products to be attractive and usable to the greatest extent possible by everyone. For example, writing content in a clear and simple style and implementing intuitive navigational elements in your learning materials benefits all learners and, in particular, facilitates use by learners whose native language is not English, as well as learners with learning difficulties or cognitive disabilities.



Inbuilt accessibility features on an iPad

## Diversity and inclusiveness

Universal design (UD) benefits all learners by placing a high value on both diversity and inclusiveness. The core principles of UD as applied in the education context are:

1. **Equitable use.** The design of the digital learning materials and environment are useful and usable to learners with diverse abilities.
2. **Flexibility in use.** The design of the digital learning materials and environment enables a wide range of individual preferences and abilities.
3. **Simple and intuitive use.** The design of the digital learning materials and environment are easy to understand, regardless of the learner's experience, knowledge, language skills, or current concentration level.
4. **Perceptible information.** The design of the digital learning materials and environment communicates necessary information effectively to the learner, regardless of the learner's sensory abilities.
5. **Tolerance for error.** The design of the digital learning materials and environment minimises errors and easily allows for the correction of unintended actions.
6. **Low physical effort.** The design of the digital learning materials and environment can be used efficiently and comfortably and with a minimum of fatigue.
7. **Size and space for approach and use.** Appropriate size and space in the design of the digital learning materials and environment is provided to enable all learners to freely and easily interact and control it irrespective of their physical characteristics and abilities.



### Design criteria

Before educators can universally design flexible learning materials and environments, they require answers about the learners and their context.

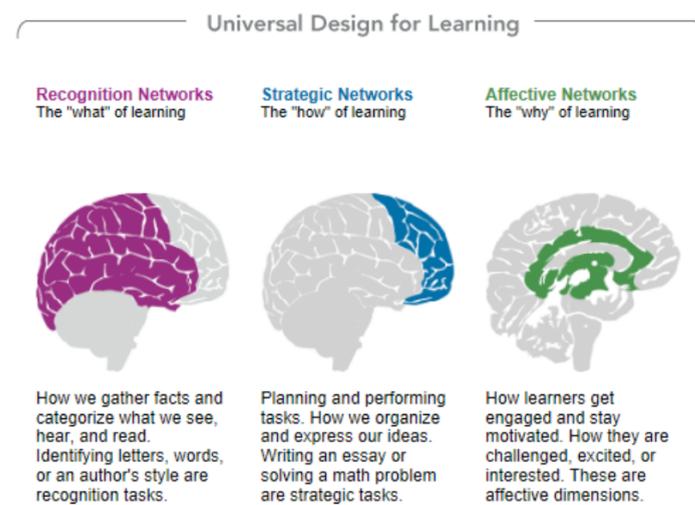
### Learner variability

*Universal design for learning (UDL) is a framework that addresses the primary barrier to fostering expert learners within instructional environments: inflexible, one-size-fits-all curricula. It is inflexible curricula that raise*

*unintentional barriers to learning. Learners who are in the margins, such as learners who are gifted and talented or have disabilities, are particularly vulnerable. However, even learners who are identified as average may not have their learning needs met due to poor curricular design ... UDL helps address learner variability by suggesting flexible goals, methods, materials, and assessments that empower educators to meet these varied needs.*

CAST, 2011 p. 4

Building upon Mace's pioneering work on universal design is the ongoing pedagogical and neuroscientific research by the [Center for Applied Special Technology](#) (CAST) into universal design for learning (UDL). UDL extends universal design by incorporating research on such concepts as the Zone of Proximal Development, scaffolding, mentors, and modeling. Furthermore, UDL draws upon current neuroscientific knowledge that our learning brains are composed of three different networks, recognition, strategic, and affective. The key message for educators from CAST's research is that learner variability is as diverse and unique as our DNA or fingerprints and as such, learner variability is the norm rather than the exception.



Screen shot: [Universal design for learning](#), CAST

At a base level, educators recognise that all learners are different and that the only *norm* is learner variability. The crucial element is moving beyond just recognising that every learner is unique and asking how we nurture all learners to become expert learners. This requires considered thought about how we respond to learner variability.

We must ensure that learning materials and experiences provide flexibility in how learners:

- access information
- reflect upon it
- respond to it
- demonstrate understanding of it.

In other words, we must provide flexible goals, methods, materials, and assessments. By doing so, we create

learning environments that are engaging, accessible and culturally responsive, and that scaffold and sustain novice learners in their journey to becoming expert learners.

### Anticipating learner variability

One of the curriculum design errors that educators can make is focusing on the content and or the technology first, rather than looking at who the learners are and what are the desired learner outcomes. Putting the technology and/or content first, predetermines our thinking about design of the learning and the needs of the learners. In the first phase of the design process educators should have a clear understanding of the:

- lesson or unit goal(s) and how they relate to specific learner outcomes
- barriers associated with the curriculum as it related to learner variability within their environment.

If these two points are teased out further, it involves educators understanding:

- learner preferences need for how they will:
  - access and process information
  - engage with the content
  - express what they know and understand
- learner strengths and weaknesses

- specific to the goals of the resource
- ideas on how to scaffold for learner variation in learner background knowledge.

Answers to these questions will greatly influence the design decisions educators make about the type and nature of content and interactions that is proactively designed into the learning materials and environment to support all learners.

### Learning from industry

Learning from other industries or perspectives is a well-recognised technique for gaining fresh insight into any design issue. Both the World Wide Web Consortium (W3C) and Apple have developed design resources that are extremely useful reference points for educators in designing inclusive digital learning materials and environments. It is important to highlight that the W3C resources are quite technical documents, as are parts of the Apple's user experience guidelines for developers. That said, when the resources are deconstructed and distilled there is much that educators can learn from. The key points of the resources are discussed further in this document. The W3C through its Web Accessibility Initiative (WAI) has developed two internationally recognized resources that

both web developers and governments reference and use as international standards. These resources are the *Web Content Accessibility Guidelines (WCAG 2.0)* and the *Guidance on Applying WCAG 2.0 to Non-Web Information and Communications Technologies (WCAG2ICT)*.

Irrespective whether the digital learning materials and environments are web based or not, [WCAG 2.0](#) are the standards to reference against. The reason being as noted by the Web Accessibility Initiative Taskforce is that *the majority of success criteria from WCAG 2.0 can apply to non-web documents and software with no or only minimal changes*. As Hollier highlights, the applicability of WCAG 2.0 to non-web ICT is no accident. Given that it was designed to be a technology-neutral standard, it stands to reason that it will be applicable for use in other technologies.

[WCAG 2.0](#) are based upon four technology-independent principles of accessibility, which is then supported by techniques to achieve those principles as well as criteria for success. The four principles require that the content and how the content is interacted with and/or controlled must be perceivable, operable, and understandable to all learners. It must also be robust enough that if required, it can be reliably used

with assistive technologies such as a screen reader or switch. If any of these were unable to be met then learners with disabilities would be unable to use the learning material or environment.

The principles lay the foundation required for all learners who wish to equitably access and use web content. The successful application of these guidelines in the design of digital learning materials and environments is integral to compliance with [Disability standards for education](#) (2005).

Apple's *User experience guidelines* for [mobile](#) and [computers](#) provide software and website developers insight into design techniques for anticipating and responding to user variability that directly impact upon affect (engagement) and usability (productivity), both which are common concerns to all teachers. Apple's *User experience guidelines* incorporate both the *Human interface principles* and *User experience guidelines* which are based upon multi-disciplinary fields, incorporating aspects of psychology, anthropology, sociology, computer science, graphic design, industrial design and cognitive science. The discipline of education shares many common features with most if not all of these disciplines. Reflecting upon Apple's *User experience guidelines* some of the design questions that arise

in the education context are:

- How easily can learners accomplish basic tasks within the learning materials/environment the first time they encounter the design?
- How will learners perform higher-level tasks within the learning materials/environment?
- How will learners recover from making an error?
- How well does the appearance of elements within the learning materials/environment integrate with its function?
- How does the learning materials/environment allow learners to transfer their knowledge and skills to another resource?
- How do learners directly manipulate onscreen objects?
- How does the learning materials/environment provide learners with feedback of their actions or progress?
- What metaphors are used with objects and actions in the learning materials/environment to anchor learners' thinking?
- How does the learning materials/environment leverage the wide array of inbuilt accessibility options to enable learners to personalise how they perceive content and interact with their devices?

- How are the goal(s) of the learning materials and specific learner outcomes communicated clearly to the learner?
- What potential misunderstandings, misconceptions, and areas where learners may meet barriers to learning did you identify?
- What strategies were applied to address the goals and learner variability?
- How are checkpoints embedded to ensure all learners are successfully meeting their desired outcomes?

### Learning devices

21st century learners are not constrained to one type of learning device. Learners may be using anything from laptops to tablets or smartphones. Acknowledgement of this issue becomes another fundamental criteria of the design process. Successfully responding to this design criterion involves ensuring that learning resources and environments can be easily accessed from and used on a variety of learning devices. The key design suggestions for educators are to:

- use industry standard open file formats that work across devices. For example, for text documents use .rtf rather than the proprietary .doc or

docx. That said, while Adobe's .PDF has been an open standard for some years, it is recommended to move away from its use as not all devices can open PDFs and, in many cases, Acrobat documents have been based on inaccessible content.

- create content that is flexible enough to be able to reflow on any device without effecting structure and meaning, as screen sizes and orientation are not set.
- consider classes of tools that achieve a particular task rather than specific apps. It is no longer possible to guarantee every learner has the same software / apps on their learning device. For example, not all devices can use Microsoft Word and thus open .doc or .docx file formats. It is better to think of classes or types of open-ended apps such as text, photo, sound, spreadsheet and video editors, and presentation tools.

### New ways of learning

#### Implementation strategies

As mentioned at the beginning of this article, the [Australian Curriculum](#) creates a requirement for new and or revised learning materials. This presents educators with the opportunity to ensure that all new digital learning materials and environments are

designed to be accessible and usable from the ground up. The requirement to ensure the accessibility of the digital learning materials applies not only to web content, but all digital content such as a word document, a video or a MultiTouch iBook.

As part of implementing a more accessible and usable learning environment, schools should:

- evaluate the digital learning platforms and authoring tools in use to examine if they support or hinder the creation of accessible and usable learning environments.
- identify the level of WCAG 2.0 compliance with existing learning materials.
- prioritise and establish timeframes for achieving WCAG 2.0 compliance with existing learning materials and environments.
- align the creation / curation of digital learning materials /environment against the Australian Professional Standards for Teachers. In particular; Standards 2.2, 2.6, 3.3, 3.4, 3.5 and 4.1.

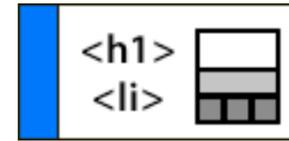
### Accessible and usable design principles

The design principles that follow are based upon the W3C's [WCAG 2.0](#) guidelines and the *Guidance on Applying WCAG 2.0 to Non-Web Information and Communications Technologies*

(WCAG2ICT). Elements of universal design, universal design for learning and Apple's human interface guidelines have been intertwined as well. This is consistent with the draft Accessible Digital Learning Materials—Publisher/ Developer Best Practices Guidelines recommended by the [U.S. National Center on Accessible Instruction Material](#). The focus is on increasing learner inclusion, engagement and comprehension through universal usability. As such it includes but goes beyond accessibility.

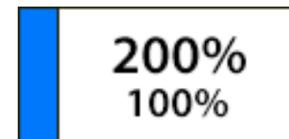
**Design Principle 1: The content of the learning materials/ environments must be perceivable to all learners**

Ask yourself, what formats are the content in and how will the learner be able to personalise how the content is perceived?



### Semantic structure

Information structure is created by applying consistent paragraph styles such as titles, headings, body, lists, table headings. Information structure helps to ensure reading and navigation order is created in a logical and intuitive manner.



### Resizable and reflowable

Content and in particular text should be adaptable and flexible to ensure it reflows cleanly irrespective of the font magnification of 200, device size, orientation.



### Text alternatives for non-text content aids meaning

Every non-text element needs a text alternative (alt text) that provides an equivalent to the image content. As much as possible, accessibility descriptions should concisely focus on the content and function of each image rather than its visual appearance.



### Captions and alternatives for audio and video content aid meaning

Closed captions are a text representation of the dialogue and other audio content in a video program. Closed captions benefit not only people with hearing difficulties, but also struggling readers and those learning in a second language. A minimal alternative is a text transcript.



### Colour supports meaning but it cannot be the only form of meaning

Learners often can't distinguish or may override page colours. As such, colour cannot be the only way information is conveyed.



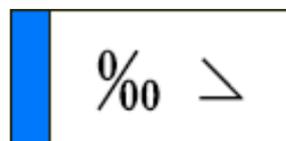
### Sufficient contrast to make things easy to see and hear

The greater the difference between the key information (signal) to any distracters (background noise, colour contrast ratio), the better the comprehension.



### Typographic

Font choice and line spacing impacts on reading efficiency (speed/ comprehension) levels. The readability of any given font is determined by the height of the lower case x and cross bar on the t. Serifs such as Times blur more on screen decreasing readability. Similarly single line can make the lines of a paragraph blur together. Using sans serif fonts such as Verdana with a line spacing of 1.2 - 1.3 increases readability.



### Mathematical

Use of Mathematical Markup Language (MathML) to describe mathematical notations as it captures both its structure and content.

**Design Principle 2: The content of the learning materials / environments must be operable by all learners**

Ask yourself, what formats are the content in and how will the learner be able to personalise how they control the elements within the learning materials?



### Enough time to read, review and use content

If rich media is used, provide a play/pause/rewind button.



### Moving content

Use animations sparingly as they can be a distractor. Best only used to demonstrate concepts or processes. Avoid flashing or strobing content as it can cause seizures.



### Location and order

The navigation order of links, form elements, etc. is logical and intuitive. An indication of the current page location is providing (breadcrumbs) as is specifying the current step in a sequence (eg Step 4 of 6 - adjusting the seat).



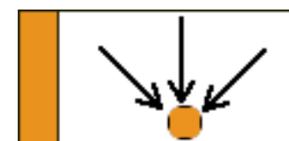
### Functional control

All functionality should be able to be accomplished using multiple formats (keyboard, mouse and, where appropriate, gestures).



### Ensure the link is recognisable and makes sense on its own

The purpose of each link (or form, image button or image map hotspot) can be determined from the link text alone. Avoid *Click Here* and other ambiguous links.



### Multiple ways

Providing multiple ways to find content caters for a list of related pages, table of contents, site map, site search, or list of all available web pages.

### Design Principle 3: The content of the learning materials / environments must be understandable to all learners

Ask yourself, what formats are the content in and how will the learner be able to personalise how they understand the elements within the learning materials?

**12 yrs**

#### Easily understand its meaning

Sentence structure should be clear and concise. The maximum reading age of the content should be 12 years. Usability and eye tracking research indicates lower reading efficiency on low resolution screens.



#### Glossary

Provides clarification of vocabulary and symbols for all learners for all ambiguous, unknown, or jargonistic words through a glossary, or other suitable method. This should also include the pronunciation.



#### Interact with the resource in predictable ways

Decrease cognitive load through consistent navigation and control elements in the resource.



#### Avoid and correct mistakes

If a learner makes an error, how does the resource provide suggestions for fixing the input in a timely and accessible manner?



#### Accomplish basic tasks the first time they encounter the design

How intuitive is the resource to use? What instructions, labels and cues are provided in context to enable the learner to complete the task?



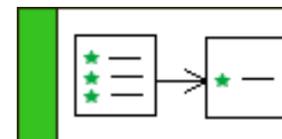
#### Self-mastery/ feedback

Learners will remember 25% more information if there is a simple self evaluation activity with instant feedback at the end of long articles or topics.



#### In context support

Provide instructions, cues and coaches in context to help learner understanding and transference of knowledge.



#### Summaries

Summaries can be used to aid memory, and to maximise the transfer and generalisation of information.



#### Mind maps

Mind maps allow learners to see how ideas are connected, and to realise how information can be grouped and organised.



#### Virtual coaches

Virtual coaches can prompt learners to stop and think. Virtual coaches also enable the modelling of successful decision-making with competent mentors. As an alternative, use Call out boxes with a defined paragraph style.



#### Rich media

Rich media and multimodal formats such as simulations, images or interactive graphics can be more effective communicators of concepts or processors. Where possible, these rich media formats should be captioned or have an available text description.

Design Principle 4: The content of the learning materials/ environments must be robust for all learners

Ask yourself, what formats are the contents in, and how smoothly and seamlessly do the learning materials and environments work with inbuilt accessibility settings of different learning devices?



#### Control using accessibility options

1. Screen reader: Narrator or JAWS (PC), VoiceOver (Mac/iOS) or Eyes-Free (Android).
2. Single switch access.



#### Control using different devices and browser independence

Use across browsers, assistive technologies and mobile devices.

#### References and further reading

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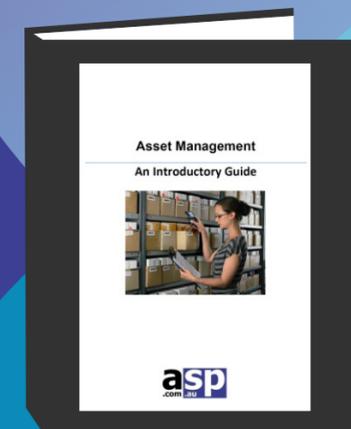
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