

## Expanding horizons for students with dyslexia in the 21st century: universal design and mobile technology

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**This paper discusses the role of mobile technology in supporting people with dyslexia within the theoretical framework of Universal Design for Learning. The authors discuss how students with dyslexia can use mobile technology to address a diverse range of academic needs (such as reading, composing text, notetaking, metacognition and studying skills). Curriculum issues and teacher training are also examined.**

### Introduction

There have been many suggestions as to the best way to educate students with learning disabilities, such as dyslexia, over recent years. Educational trends in this area have been cyclical – segregation, integration, inclusion, and many shades in between. Through it all, there have been some excellent examples of unit provision, special schools, whole class approaches, and thematic learning based on practices incorporating the social, emotional and the learning needs of all children (Reid, 2012a), peer-assisted learning (Reid, 2012b; Topping, 2001) and peer mentoring (Flink, 2012).

One theoretical framework that incorporates the evidence-based practices described above to best support the delivery of the standard curriculum to all students is Universal Design for Learning (UDL; CAST, 2011a). UDL is an educational framework based on research in the learning sciences that guides the development of flexible learning environments (CAST, 2011a). It is defined as:

*‘a set of principles for curriculum development that give all individuals equal opportunities to learn. UDL provides a blueprint for creating instructional goals, methods, materials, and assessments that work for everyone – not a single, one-size-fits-all solution but rather flexible approaches that can be customized and adjusted for individual needs.’*

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UDL involves planning the classroom environment and instruction so that it is accessible for all students from the start, without the necessity of adaptations or modifications. This is important, as adaptations or modifications usually require time for a request to be made, considered and then granted.

CAST (2011b) describes the framework as having three guiding principles: (1) provide multiple means of representation; (2) provide multiple means of engagement; and (3) provide multiple means of action and expression. These three principles, and the Universal Design for Learning Model itself, are now widely accepted and incorporated into several best practice teaching models, including the popular explicit instruction (Hall, 2009) and differentiated instruction models (Tomlinson, 2008).

Another educational tool that is rapidly gaining popularity is mobile technology. This includes smartphones, mp3 players such as the iPod, and tablet computers. Youth and adults alike have adopted mobile technologies not only for leisure activities such as listening to music and playing games but also for keeping organised and for assisting with learning. Education has traditionally been a field slow to adopt new technologies, but these technologies have been embraced, in the school sector as well as the public sector, with over 1.5 million iPads deployed in educational programs in the USA alone (Apple Press Info, 2012). Through inexpensive mobile applications (apps) that can be downloaded to and used on the devices, mobile devices appear to have unlimited potential for individualising teaching, learning and communication. The functionality of these devices is through the use of apps, which customise the equipment to each individual, potentially converting them into the equivalent of a ‘digital education prescription pad’. The ability to customise a popular device to suit the needs of each individual student is motivating because it gives students with special needs something mainstream and non-stigmatising that is still engaging and interactive for them.

The educational use of mobile devices and their associated educational applications fits in well with the principles of UDL. In other words, students of all abilities should be

given every opportunity to learn, in the style that works best for them, in both educational and community settings, and this technology is one tool that can be accessed to help accomplish this.

Classroom use of mobile technology and its associated educational applications are well suited for all three of UDL's principles. The many applications that are available for downloading on the devices give students with dyslexia the ability to be successful in inclusive settings by allowing them to have individualised technology tool-kits at the fingertips. Used and customised correctly, this technology aligns well with UDL as it can provide multiple means of representation, engagement and expression, and benefits all students, allowing them to experience learning in the modalities they are strongest in. Because of its portability, the devices can be carried and used anywhere, thus strengthening the ties from school to home and the community.

Although accommodations and modifications to the environment, the curriculum, teaching and learning are commonplace in the field of special education, Edyburn (2010) discusses how optimum UDL implementation involves accessibility from the start rather than accommodation because accommodation, which is usually instigated by a request, can take time to design and implement. It may also require extra effort in the form of time and resources, or moving to a special location, which is exclusionary. Accessibility is an integral feature of UDL.

Tablet devices, such as the iPad, and their corresponding applications have the potential to increase the accessibility of educational materials, such as text, and enhance the presentation of concepts, as well as giving students a way to express themselves in different modalities. The devices are also widely recognised and used by students of all ages, making them more readily adopted by students with disabilities and their peers. Many schools are already widely employing the devices, making it a matter of just adding the right applications to make classroom instruction more accessible to all students.

#### **Addressing the needs of students with dyslexia**

Learning is a dynamic process. During this process, different parts of the brain interact with the other. For example, the various parts of the brain that deal with visual/auditory/memory/understanding/coordination may all be used simultaneously to tackle a task. Reading can be described as a holistic activity because it utilises a combination of brain activities. It is therefore a holistic activity that requires simultaneous processing of different components and a degree of task specialisation. It is often this simultaneous use of learning skills that is challenging for children with dyslexia. For that reason, tasks need to be differentiated, structured, clarified and preferably focused towards the student's stronger areas of learning.

There are different approaches to dyslexia, depending on the areas of expertise and knowledge different theoreticians

might have. Thus, the most common difficulties students with dyslexia have (in writing, reading and spelling) can be understood and related to the language-related components, or the visual components or the need for rapid cognitive processing (Fawcett, 2001) The authors of this paper share the belief that dyslexia is a difference in how people process information (Reid, 2011).

Students with dyslexia learn more efficiently when material is presented visually. They can experience even more success when they have the opportunity to interact with material kinesthetically. Thus, ensuring that teaching and learning is multisensory is a crucial aspect of success for students with dyslexia (Reid, 2011). Multisensory learning involves auditory, visual, kinesthetic and tactile input, and tablet computer devices lend themselves well to all of these modes. Furthermore, the true functionality of these devices is through the ability to customise each device to its user with different applications. This again aligns with the UDL principles of providing multiple means of representation, engagement and expression.

There are innumerable applications available, and more seem to appear every day. Although many of these applications are designed to entertain, many more are designed to educate, some specifically for students with dyslexia and other disabilities. Still, others are designed to assist people in keeping their lives organised, and these may also be useful to students with dyslexia. The biggest challenge seems to lie in finding the right applications to assist a student with his/her daily and learning needs.

Assessment of the student's needs is therefore the starting point to discovering how (and if) mobile technology can benefit that individual. In the spirit of Universal Design for Learning, assessment of student needs should be a classroom practice employed with all students, to discover where each could best be supported. A range of materials should be used, and the teacher needs to be empowered to take some responsibility for the assessment process – to observe, identify, monitor and choose the appropriate applications based on a solid and sound framework. Ultimately, it is wise to remember that the technology should be adapted to the child, not the other way around.

One example of such an assessment tool is the framework developed through Dyslexia Scotland and the Scottish Government by Crombie and colleagues <http://www.frameworkforinclusion.org/AssessingDyslexia/> (accessed October 2011) Defining difficulties and finding appropriate supports is a question of problem-solving. It is important to

- Discover the difficulties the learner experiences and her/his views
- Consider the views of the learner's family
- Assess barriers to the student's learning in the classroom environment and in the particular curriculum area
- Think about the requirements of the particular curriculum area

- Reflect on what will best address those barriers to help the learner to achieve in the classroom (Reid and Green, 2009).

Once the student's needs are assessed, a plan can be put into place to most effectively address those needs. If this plan includes mobile technology, then decisions must be made as to how to use the technology to best support students both in and out of the classroom. Students with dyslexia will most frequently require assistance in the areas of reading, writing, spelling, and organisation. Choosing appropriate applications that fit both curricular goals and the needs of the students can be a daunting task, even for the most empowered teachers. To discover both the best applications available for specific goals and determine if they are right for individual students, it is recommended that teachers take a two-pronged approach. First, they can access information on the applications that are being used successfully by other teachers, parents and support professionals by reading their advice on various websites and blogs dedicated to using mobile technologies for students with dyslexia (see Table 1). Second, they should employ the use of an application evaluation rubric, such as the *Evaluation Rubric for Educational Apps* (Walker, 2011). This rubric purports to measure curriculum applicability, authenticity and differentiation, along with important user factors, such as friendliness and motivation.

### Mobile technology toolkits

As previously mentioned, one of the greatest benefits of mobile devices is their customisability. A tablet device affords students the ability to have a virtual technology toolkit at their fingertips. The following section discusses ways that this can be accomplished through the use of different applications and looks at how they can be used to support students with dyslexia in inclusive settings. The costs of these apps range from free to around \$50 AUD (i.e., 40, Eur or 30, GBP).

#### Reading

Reading text is one of the main areas of academic difficulty for students with dyslexia. Many mobile devices also have a read-aloud function built-in as part of their accessibility package. In addition, there are a myriad of applications that can be downloaded to a mobile device to assist students to be more independent and efficient readers by reading any text inserted into the application aloud. Many, such as *Goodreader*, have additional features, such as reading pdf files and allowing the user to annotate in the documents that are downloaded. *Speak It!* allows students to hear emails and other text read aloud and also offers the function of being able to save the spoken text as audio files that can be saved and/or emailed. *Web Reader* is an app designed to read online content such as web pages or blogs aloud. *openWeb* app allows people to customise their web browser (e.g., adjusting font size and colour), using *OpenDyslexic* (a dyslexic-friendly font).

Talking storybooks and textbooks can assist students with learning content. There are also a large number of applica-

tions that purport to teach reading, build fluency and increase comprehension. Many of these do so in the form of reading games and are engaging and entertaining. They are too numerous to mention specific apps, and vary greatly in content and quality, so the recommendation for these tools, as with all of them, is to fit the technology to the academic and curricular needs of the student.

#### Composing text

Dynamic word processing applications can be very useful tools for students with dyslexia, who often have difficulties composing text. *AppWriter* is an app that features text-to-speech, context-based word suggestions and optical character recognition to help with reading and writing. It also contains the *Dyslexie* font, which has shown to decrease reading errors of people with dyslexia (de Leeuw, 2010). A similar word processing app, *Textkraft English*, also functions as a dictionary, thesaurus, grammar and spell checker. It connects directly with online dictionaries and Wikipedia. Both of these apps allow students to save in other places such as *Pages* or *Dropbox*, as well as printing functionality. Giving students alternate ways to compose and present written material will provide them with more opportunities for success in language arts. These apps and others like them provide students with alternate ways to engage with writing, by assisting students with the actual writing process, not just with proofreading what they have already written. Which is the best word processing app? That depends on the needs of the individual using it, so teachers and parents are encouraged to look at several apps, use rubrics and student needs to evaluate each, then choose the one best suited for the individual student.

#### Notetaking

Notetaking is another area where having a toolkit can benefit students with dyslexia. There are a number of good notetaking applications, as well as applications that can also assist with writing by providing students with speech-to-text tools. *iTalk* is a simple recording application that enables the student to record whatever is going on, such as a lecture or group discussion. *AudioNote* has more functionality, as it includes text notetaking that is aligned with the audio recording. Students can click on the notes s/he has taken and access the audio recording at the point in time that the notes were written. *Dragon Dictate* is a speech-to-text app that is good for memos and short notes, but background noise and variations in student voice can affect its accuracy. *Dragon Go!* allows the user to speak what s/he is looking for on the web and completes a search through sites such as *Google*, *Wikipedia* and *YouTube*.

#### Organisational skills

Staying organised is a skill that escapes many students, and one which students with dyslexia may have particular difficulty with. Organising time, planning assignments and work in general might be a challenge for students with dyslexia. *iCal* is a suitable application allowing students to keep track of time and efficiently plan activities.

Making lists is a good reminder of tasks that must be completed, but keeping the lists in a place where they are easily

**Table 1: Electronic resources for finding applications to support students with dyslexia**

Website URL	Title	Author	Description
<a href="http://dyslexiahelp.umich.edu/tools/apps">http://dyslexiahelp.umich.edu/tools/apps</a>	Apps for Dyslexia and Learning Disabilities	University of Michigan Institute for Human Adjustment	Part of the Dyslexia Help site. Descriptions of and links to applications to help with reading, writing, spelling, phonics, organisation, study skills, resource and reference and Math.
<a href="http://a4cwsn.com">http://a4cwsn.com</a>	Apps for Children with Special Needs	Dr Gary Brown	Information about apps and videos that demonstrate how apps work from a user perspective. Also has a community of users, blogs, reviews and a program to help children with special needs get iPads.
<a href="http://dyslexicadvantage.com">http://dyslexicadvantage.com</a>	Dyslexic Advantage	Drs. Brock and Fernette Eide from the Eide Neurolearning Clinic	Reviews, links and news relating to mobile technology and dyslexia.
<a href="http://momswithapps.com">http://momswithapps.com</a>	Moms with Apps	Site created by four mothers interested in creating educational technology for their children.	Supports family-friendly developers seeking to promote quality apps for kids and families.
<a href="http://dyslexicbrain.com">http://dyslexicbrain.com</a>	Dyslexic Brain	Administered by Lorraine Akeman Goga and Antonio Farruggia-Bochmk.	Links to apps that they feel are worthwhile Reviews of iPad apps useful for people with dyslexia
<a href="http://www.funeducationalapps.com/apps-to-support-dyslexia/">http://www.funeducationalapps.com/apps-to-support-dyslexia/</a>	Fun Educational Apps – To Support Dyslexia		Just one page of the Fun Educational Apps site. Links, descriptions and reviews of apps for students with dyslexia.
<a href="http://www.edtech-associates.com/resources/resources_specialied.aspx">http://www.edtech-associates.com/resources/resources_specialied.aspx</a>	EdTech Associates: Resources- Special Education	EdTech Associates	Links, descriptions and reviews of apps that are useful for students with dyslexia.
<a href="http://www.spectronicsinoz.com/online/resource/category/ipads-in-special-education/">http://www.spectronicsinoz.com/online/resource/category/ipads-in-special-education/</a>	Spectronics Resources for iPads in Special Education	Spectronics	App reviews and presentations. Much of the content on the site requires a premium subscription, but there are some free resources.
<a href="http://helpforstrugglingreaders.blogspot.com.au/2012/07/android-apps-for-dyslexia.html">http://helpforstrugglingreaders.blogspot.com.au/2012/07/android-apps-for-dyslexia.html</a>	Help for Struggling Readers Blogspot	Joan Brennen	Lists, describes and links to Android apps for students with reading difficulties.
<a href="http://dyslexiauntied.blogspot.com.au/2012/10/reading-disabilities-50-useful-apps-for.html">http://dyslexiauntied.blogspot.com.au/2012/10/reading-disabilities-50-useful-apps-for.html</a>	Reading Disabilities: 50 Useful Apps for Students	Dyslexia United	Lists, describes and links to 50 iPad apps useful for students with reading disabilities.

accessible is another task in itself. *Chorepad*, *Checklist*, *ColorNote* and *Evernote* are applications that can be used to jot down tasks, and tick off tasks as they are completed. They each have different functionalities such as photo notes, colour coding and the ability to share the lists with groups of people, which is handy when working on group projects. *Nudge* can be set to remind the user to do something. It will keep giving push alerts until it is shut off. Other apps were designed specifically for students. *CourseNotes* allows students to organise and colour code notebooks and add teachers. Students can also add and track assignments and their deadlines. *EverStudent* synchs with *Evernote* and allows for the organisation of assignments and due dates. *HomeWork* keeps track of assignment due dates and test dates.

#### *Metacognition and studying skills*

As suggested by several authors (Reid, 2011; Tunmer and Chapman, 1996), students with dyslexia often have difficulty with the metacognitive aspects of learning. They need support to adopt appropriate learning behaviours and to learn how to learn. Some of the important questions that a student needs answer for him/herself when deciding on how to tackle a new task are: ‘Have I done this before? How did I tackle it? What did I find easy? What was difficult? What did I learn? What do I have to do to accomplish this task?’ (Reid, 2003) When developing these metacognitive strategies, mind-mapping tools, such as *MindNode*, *Inspiration*, *MindNotes* and *iThoughts*, might be helpful.

Studying combines all of the skills mentioned above and can be particularly difficult for some students. Mobile learning tools that can assist with this process include the apps listed above, along with electronic flashcard applications (*AnkiDroid* and *Flashcards Deluxe*) and annotation apps.

The learning success of students with dyslexia is sometimes slowed down by problems in working memory (Reid, 2003). A fun way to strengthen working and auditory memory (along with phonological awareness, processing speed, visual memory, and sequencing skills) is a game application designed for three age ranges, *Dyslexia Quest*.

For students that experience difficulty staying on task, *StayOnTask* is an electronic reminder that checks on progress at random intervals. *TimeTimer* is a visual timer that students can set for whatever interval is appropriate. These tools can help to tailor studying to each individual’s pace and learning style.

#### **Curriculum issues**

Ideally, all intervention, mobile technologies included, should be integrated in some way into the curriculum. This transfer from specialised input to the main body of the curriculum is very important.

Curriculum-based intervention can present two difficulties:

- The development of strategies to help the student cope with his/her dyslexic difficulties

- The recognition of the difficulties in accessing the curriculum that can place the student with dyslexia at a disadvantage.

These difficulties can be minimised through the use of both Universal Design for Learning and individualisation of learning tools, such as mobile technology (Cumming and Strnadová, 2012).

It may only take some minor adjustments in planning and teaching to make a difference. Some traditionally effective accommodations include:

- additional time being provided to complete a task,
- printed handouts being provided,
- summaries of the work,
- students working together in small groups,
- grades and marking that show individual improvement so that it is meaningful for that individual student,
- marking and grading that is constructive, and
- work judged for content not spelling.

The authors contend that mobile technology allows for easier delivery of the provisions above while also encouraging students to be more independent and confident in their learning. A tablet device has the capability of storing any printed material the student needs, as well as presenting that material in different colours, fonts and sizes. The portability of the technology allows for students to work independently or collaboratively, wherever and whenever they wish.

#### **Teacher training**

Much of the success of both Universal Design for Learning and educational technology implementation rests on the level of training and how prepared teachers and schools are for the challenges that may arise during planning and implementation. When implementing any educational intervention, it is essential to establish communication with everyone working with the student as well as the parents or guardians. This is especially important when implementing educational or assistive technology, as the student should have effective tools available in all settings. A strong learning team that communicates and provides regular feedback will aid in the student’s success at school and at home. Following are some ideas that will help in maintaining a strong communication triangle between home, teacher and teaching assistant (communication with other learning support people who work with the student may be necessary and should also be encouraged):

- establish a common goal
- create a team
- build bridges between school and home
  - offer training for parents in the technology their children are using
  - sponsor regular parent technology nights where parents can share with and support each other
  - ask for regular feedback from students, teacher and parents/guardians

- use a notebook (paper or electronic) between home and school to keep a log and encourage communication
- use email to discuss any issues that may arise and include everyone on the child's learning team
- schedule regular meetings to discuss progress, goals, individual education plan, strategies, learning style and behaviour
- ensure that parents have confidence in the school by actively pursuing dyslexia-friendly policies and practices.

### Conclusions

One of the key issues in relation to successful outcomes in school concerns the notion of responsibility. It is important to ensure that the needs of students with dyslexia are met and that all members of staff become fully involved.

School management need to ensure that:

- The ethos of the school is supportive. The philosophy of the school together with attitudes and actions are known to all staff including part-time support and other staff.
- All staff should be encouraged to acknowledge that with effective differentiation the curriculum can be accessed by students with dyslexia.
- All teaching staff need to be supported to utilise some of the suggestions shown above in relation to applying Universal Design for Learning and to using mobile technology effectively.
- Parents need to be considered. Parents are a very rich support of information and assistance, and it is important that collaboration between home and school is ongoing. When using mobile technology, parents need to be informed about what apps can support their child in learning and in everyday life. They might also need training and support in this area.

It is important that these issues are fully addressed in order that the student with dyslexia can achieve some success in different subject areas. Teaching and learning should be planned together. This implies that knowledge of teaching strategies and the learner's individual strengths and difficulties and learning style are necessary in order for planning and presentation of learning to be effective.

In the title of this paper, the authors posed a question whether dyslexia, Universal Design for Learning and mobile technology present a winning combination for a student. It is generally acknowledged that there is no 'off-the-shelf' answer to dyslexia. There are many key factors that play a role in supporting students with dyslexia. These include the curriculum; the task; the level and scope for implementing differentiation; knowledge of the students individual learning style; the availability of a comprehensive and contextualised assessment at the outset of intervention; the presence of coordinated planning; a recognition by school management of the needs of teachers in supporting

students with dyslexia; and opportunities for appropriate and practical training for the whole school staff.

Although applications for mobile technologies can assist students with dyslexia with general self-confidence and specific skills such as reading, writing, spelling and organisation, they do not replace the traditional teaching and learning strategies that have a strong evidence base to support them.

The term inclusion implies that the needs of all children should be met within the mainstream school. In order for children with difficulties such as dyslexia to have their needs fully met in mainstream school, there is a need for all teachers to be at least familiar with a range of the intervention approaches and resources for dyslexia, including opportunities for students provided by mobile technology. Thus, professional development in this area, even more crucial in this digital age, needs to become an integral part of both pre-service and in-service teachers' training.

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