Work Package 2 Final Report : Learning Content Adjustments

Introduction:

Each student within a learning environment possesses a unique and individualized set of learning needs and requirements which cannot be met through the implementation of a one-size-fits-all approach to teaching. Meyer and Rose (2002) acknowledge that there is no perfect fit in terms of teaching methods which will cater to the needs of all students. However, despite this recognition being in existence within the literature, in many cases, alternative approaches and alterations to the standard teaching templates are given consideration only in the cases of students with disabilities, and are also only implemented in a reactive rather than proactive manner. Another noteworthy point emerges from the manner in which the learning needs of students with disabilities are considered. Within the pedagogical sphere, it is common that students with different disabilities are grouped into distinct and separate categories. However, this is a viewpoint which should be challenged. It is more reflective of the nature of disability to consider these students as falling along a continuum of learner differences rather than cordoning off individuals into such distinct and separate groupings.

In order to address some of the above issues, the manner in which students receive information, digest said information, and are assessed regarding their knowledge in relation to this information requires consideration and revision. Classroom practice and teaching methods should endeavour to become more responsive to the needs of all learners within the environment, with technical adjustments seeking to satisfy the needs of every student rather than just those of the students with disabilities. Increased proactivity in teaching methods is also desirable. This can be enhanced through the provision of varied and diverse materials in a variety of forms and modes of presentation. Equally, the aim of the educational programme should not simply be geared towards remediating students in order to enable them to be capable of learning from a rigid and unchangeable established curriculum. Instead, the educational programmes being put into practice should be sufficiently versatile and flexibleso as to possess the capacity accommodate the diverse learner differences.

The Universal Design For Learning provides a framework which can guide the transition from the previous restrictive and reactive learning programmes to more proactive learning programmes which aim to include every student by catering for their learning needs and enabling students to maximize their potential by utilizing their strengths.

Universal Design For Learning (UDL):

The Universal Design For Learning (UDL) emerges from the principle of Universal Design in Architecture, which is based upon preempting and anticipating any potential accessibility issues which may arise and catering for these issues in the original design rather than waiting for the issue to arise and having to react with a haphazard compensatory measure (i.e. fit the building with wheelchair ramps during the construction process rather than waiting until an individual in a wheelchair is seeking to enter the building). The UDL functions in a very similar manner when applied to a classroom setting – the emphasis is placed upon the anticipation of potential issues and the implementation of appropriate modifications to the curriculum from the outset in order to avert these pre-outlined issues.

UDL aims to assist every student to maximize their learning and potential, and firmly asserts that learning programmes should be flexible and adjustable so as to accommodate the diversity and individual differences of the students. Students should not be forced to conform to one single, rigid curriculum. The waysin which students learn varies, and every students deserves and requires the opportunity to acquire the requisite knowledge in the manner which best fits with their own learning style and learning needs. The "universal" in the Universal Design for Learning does not refer to the existence of a single, one size fits all approach which satisfies the needs for everyone. Instead, it pertains to the requirement for a fundamentally versatile and customizable learning materials, assignments, assessments, and activities (Hitchcock, Meyer, Rose, & Jackson, 2002).

The purpose of UDL is not to reduce the level of academic complexity of the presented information but rather to ensure that the content is accessible to every learner within the classroom through the removal of obstacles. Teachers should attempt to impart a high standard of teaching to all learners, however a classroom may include individuals who have difficulty with learning for a multitude of reasons.

The Three Core Principals of UDL

CAST, a nonprofit education research and development company, work in pursuit of the expansion of learning opportunities for all individuals through UDL and have outlined three underlying principals, rooted in neuroscientific research, which provide the underlying bedrock of the framework:

1. **Provide Multiple Means of Presentation**

This pertains to the manner in which we collate information, determine what it is we are observing, hear and read information – in broad terms, it relates to the "what" of learning, in response to recognition networks. Within an inclusive and flexible classroom environment, students will have information imparted to them via a variety of sensory channels or media – auditory, visual, tactile, kinaesthetic etc. By providing this variety, the student has a multitude of ways in which they can come to comprehend the desired learning outcomes and can focus upon and utilise the medium (or blend of media) which best suits their learning needs and styles. Effective, flexible, customizable and diverse presentation of information is essential in the development of a mobile application. Perceptions, language, symbols and comprehension or mode of comprehension pf the students all require consideration in relation to the principle of multiple means of representation. The specific learning content adjustments which will be incorporated into the development of the mobile application will be outlined below.

2. **Provide Multiple Means of Action and Expression**

This relates to how tasks are planned and completed, and how ideas or concepts are compiled, arranged and expressed – it broadly refers to the "how" of learning in response to Strategic Networks. Strategic learning can occur in a variety of forms such as completing an essay or finding the solution to a mathematical problem. Within an inclusive educational environment, opportunities should be made available to every student to learn, interact with and display their command of the required knowledge in a variety of differing ways. Among the many possible waysto interact with and express ideas and concepts are through essay writing, artwork, poetry, brief orations, active expression, and worksheet completion. Throughout thedevelopment of this application, it will be important to be cognisant of

physical actions, expressive skills and fluency, and executive function using audio image and text. Learning content adjustments in relation to the provision of multiple means of action and expression pertaining to this specific mobile application will be detailed below.

3. Provide Multiple Means of Engagement

This principal relates to the ways in which learners are engaged and motivated to learn, and the manner in which they are stimulated, challenged and interested within an educational environment – it broadly pertains to the "why" of learning in response to Affective learning. Within the educational environment, the content provided must be relevant to the students, and examples provided as part of the learning experience should be of personal significance and interest to the learners themselves. Flow theory (Shernoff et al., 2003) and Stretch zone theory (Ben-Shahar, 2007) are two theoretical models which can be availed of in order to create achievable challenges within the classroom environment.

The Universal Design For Learning with provide a solidfoundationsduring the development of the mobile application for the ALSo project. Through the application of the principals of UDL, the application will ensure that learning content adjustments are available that will boost the accessibility of the applications for learners with wide ranges in their capacity to see, hear, speak, move, read, write, understand English, comprehend arithmetic and mathematics, attend, organise, focus, engage, and remember. These learning content adjustments will now be outlined, beginning with more general adaptations, before moving on to more specialised adjustments.

Universal Design For Learning Template

The ALSo project does not intend to implement all aspects of the Universal Design for Learning when designing the application for this project. The projects intends to focus on how to best adapt the same learning materials so as to cater for the learning requirements of a range of varied learning requirements. However, in order to do this, aspects of the Universal Design for Learning provide an insightful and useful template aroundwhich the learning content adjustments can be formulated.

Multiple Means of Presentation

Visual Presentation:

The capacity should exist within the application to adjust the size of the items and font presented on screen at all times to aid those with visual impairment, and a minimum size of any object or font presented should be ensured. Additionally, the font type shouldbe alterable as it has been suggestedwithin the research (Waddington et al., 2015) that the use of certain font types (san-serif fonts such as Arial) may be beneficial for individuals with visual impairment.

The line width and number of words per line has also been seen to be impactful of upon readers with dyslexia (Schneps, O'Keeffe, Heffner-Wong, andSonnert, 2010; Schneps et al., 2013), thus it should follow that the functionality exists to alter the line length and width for passages of text presented within the application.

The colour of the content presented should be given significant consideration and allowances should be made for the adjustment of the brightness, contrast and colour of the content where possible. It is also

worth noting that certain visual disorders affect individual's eye movement capacities. The application should improve accessibility for individuals with issues of this nature by having the verbal stimuli and sentences scrollacross screen or by presenting all visual stimuli in the same on screen position.

Due to the prevalence of distractibility and focus related issues across a number of disabilities, every effort shouldbe made to ensure that the application possesses the capacity to remove or, at least, limit the amount of supplementary or superfluous content presented in addition to the to be learned material. The potential should exist to separate on screen object or text decisively, and the screen should remain relatively uncluttered at all times so as to ensure that learners are not overwhelmed or bombarded with excess stimulation.

A variety of visual prompts willbe available within the application in order to ensure that the prompts reflect and cater for the diverse learning needs of all learners. Included amongthese prompts should be the capacity to adjust the fading of items on screen, an on screen visual guide and the availability of an n screen spotlight to highlight areas of the screen which require attention or hold importance at a given point in time.

Audio Presentation:

The volume level should be alterable for all audio content within the application. In addition to this, the speed of all audio presentation should also be adjustable as necessary to cater for the different requirements of all learners. Allowances should be made for the amplification and the equalization of sounds within the As some auditory conditions create difficulty around sound localisation, the capacity to exaggerate the difference of sounds coming from the left or right should be included as a function in the application.

Again, as distractibility and focus related problems are prominent across a range of disabilities, a background noise cancelling function is desirable on an application of this nature. Equally, to ensure clarity in the communication of the to be learned content, superfluous audio should be avoided where possible and speech should be deliberate and easily comprehensible throughout.

Optional prompts to aid with the comprehension of auditory communications are essential to ensure the widespread usability of the application. Such prompts might include the option to enable subtitles to accompany passages of audio or the inclusion of text bubbles which complement the message being communicated duringpassages of audio within the application.

Multiple Means of Action & Expression

Planning and goal setting can be a source of some difficulty for many learners and thus this application should attempt to aid these processes via a variety of visual, auditory and kinesthetic aids where possible. Imperative to aiding the executive functioning of all learners is the provision of clear, explicit and unambiguous instructions regarding what the desired outcome is for the learner and also, how best to go about achieving said outcome. These instructions should be provided in the form of a variety of mediain order to allow the learnerthe scope to utilise the instructions which best suit their needs and will be most readily comprehensible.

Action and expression require considerable strategy, practice, repetition and organisation for the many learners. The application should have inbuilt capacity to aid the planning and goal setting process where possible. Guides for planning should be included within the application and should not be limited to just one media. Rather than solely allowing for the development of a written plan of action, the inclusion of the capacity to design a pictorial plan of the sequence of requisite steps to be completed for progressionwithin the learning environment of the application may prove beneficial for many learners.

At the core of the multiple means of expression principle is making provisions within the learning environment for the differing media through which individuals are most adept at communicating. Learners should be able to communicate and interact with the technology in a variety of different ways whether by physical action (touch or gesture), orally, via pictures or images, or in a written verbal manner (typing or on screen writing). It is important to include this level of interactivity through all stages of the application (navigation, communication, and responding etc.) to ensure the application is accessible to all learner regardless of their learner needs.

As the learner progresses through the learning environment of the application, it is important that the application is responsive to their proficiency levels and rate of progression. Graduated support should be provided as the learner practices the required action or task and also, as the learnerperforms the desired action. The application should easily allow students to identify the extent of their progress through the task and this feedback should be offered via multiple media. Regular reminders as to the desired goals and outcomes to be reached should be offered within the learning environment to ensure focus remains on the current task.

Multiple Means of Engagement

Essential to the success of an application of this nature is the application's capacity to instill commitment towards the continued use of the technology bythe learner. So, in with a view to ensuring the application will engage and maintain the learner's interest and motivation, choice as to the nature of the content to be covered and a degree of customizability in relation to the content is desirable. Equally, autonomy to dictate the direction of the learning process should also aid the engagement process and should be optimized within the application. Student interest is piqued by topics which are relevant and of value to their lives. Thus, it follows that the application should empower learners by allowing them to select and zone in on the topics and subject matter which they are most interested in. Additionally, where possible, examples used within the learning material should be ofrelevance to, and have value for the learner, so as to maximize the learner's mental investment and interest in the content. This mental interest should help foster motivation and in-task persistence, bothof which are crucial components of a successful learning experience.

Another influential factor in the maintenance of motivation and on task persistence is the level of difficulty of the material which is faced by the individual learner. This application should seek to vary the demands asked of the learner, as well as offering variation in terms ofthe resources that are required to complete the various tasks. By posing different demands, the level of in-task challenge experienced should beoptimized. However, it is equally important that the task does not overextend the capacities of the learner as this can lead to frustration and disillusionment which can undermine motivation and persistence. The application should include the option to return to a less demandinglevel for further

practice and refinement of skills if the learner is becoming frustrated or losing motivation for a particular task.

The application should also attempt to provide a variety of options for self-regulation as the learner commences and progresses through the learning environment. The application should seek to cultivate a strong sense of purpose and motivation towards making progress and advancing in the learning process. The application shouldfacilitate the development of this motivation through a variety of means. Learners should be made aware of when they are making progress through the content and should be graded to an appropriate standard so as to ensure that the students regularly experience instances of success. Along with ensuring the achievement of these minor goals is appropriately reinforced, positive on task work should also be acknowledged and reinforced to maintain a sense of motivation and harness positivity in the student. Another method of enhancing student persistence and motivation is to elevate the salience of the objectives and goals within the learning environment. The application should allow for this by enabling the tailoring of goals and objectives within the tasks to the individual learner's needs, requirements and preferences.

The presence of threat or excessive background noise or stimulation within the content can have a considerable adverse impact upon the quality of the learning experience for many students. Due to these deleterious effects, it is important that this superfluous stimulation is minimized wherever possible. When limiting these distractions, it is important to consider sensory issues across the span of all of the senses (*hearing* – volume control, *vision* – brightness, contrastetc.). It is important to locate equilibrium for each learner to ensure theyare not overwhelmed by excessive stimulation or, equally, under stimulated. Flexibility in the area of stimulus presentation is essential for this application to allow for the optimization of the learning environment in accordance with each individual learner's requirements. The information content and requisite tasks must also be tailored for the specific needs of each individual. For manylearners, excessively emotive content or aggressive actions within the task may be upsetting orunsuitable. The application should cater for these needs by providing content which is likely to create positive experiences and emotion.

Learner Profiles

Having covered the broad adaptations which should be considered for the purposes of maximising the accessibility of the application for the ALSo project, the table below outlines the individual learner profiles of those targeted as users of the application. These profiles should enable greater levels of specificity in the learning content adjustments which can be incorporated into the design of the application, all of which should boost the inclusivity of the application and enable widespread use across a substantial group of learners with a range of diverse learning requirements.

Table 1.

Learner profiles for the development of the ALSo Project Mobile Application

Category	*Disability (Medical or not) (Not Necessarily Related To A Learning DIsability)*	*Disability Detection*	*Learning Content Adjustment*

Visual			
Visual Acuity (Correctible)	Visual Acuity	Test on contrast & distinguish between a small shape in black & white. Depends upon contrast: 100% contrast, & define the smallest they can distinguish (or tell the difference between circle & square). Ask to adjust the brightness for comfort first then contrast	Adjust the contrast between the background & the foreground. Increase size of the target stimuli where possible.
Visual Acuity (Non-Correctible)	Visual Acuity (non-correctible)		
Colour Problem	Issues around distinguishing between colours	Discrimination between red & green, blue & yellow. Main pb: Distinguishing red from green Testing red & green with the same brightness. Same with blue & yellow.	Adjust the brightness between red &green, & blue & yellow.
Binocularity	Double vision, dizziness, difficulty reading	N/A	N/A
Eye Movement Disorder	Uncontrollable eye movements or both eyes do not align	Reaction time response to a visual signal. Recording eye movement during a reading task.	Make target stimuli bigger/reduce eye movements. Present the target stimuli in the exact same on screen location. Scrolling small sentences.
Cerebral Visual Impairment	Abnormal response to light. Intermittent following. Poor visual acuity. Visual field loss.	See two objects separately. Visual response increases as more options are presented.	Separate target stimuli & reduce distractions. Fade out the background. Fade in target stimuli one by one to introduce them. Present simple objects, well separated from one another
Simultagnosia	Difficulty perceiving more than one item at a given time	Cannot see multiple objects simultaneously	Present one target stimulus at a time. Limit distractions where possible.
Opticataxia		N/A	N/A
Face Recognition		N/A	N/A
Visual Neglect	Inability to attend to	Request that the	Present content on one

	items on a particularside of the visual field (left or right)	individual bisects a series of lines of varying length	side of the screen only
Auditory			
Hearing Loss	Difficulty understanding speech particularly in the presence of background noise. Difficulty hearing consonants.	Frequency and volume tests	Equalizer & Amplification
Sound Localisation	Difficulty locating the source of noise when a sound originates from in space	Interaural level & timing differences in responses when using headphones	Exaggerate difference (when noise is coming from left or right)
Tinnitus	In ear noise (ringing, buzzing hissing, roaring)	Non-testable	N/A
Auditory Agnosia	Impairments in sound perception and identification despite intact hearing, cognitive functioning and language abilities	Request that the individual distinguish phonemes in words/ create two phoneme words from two different words. Step 1: Determine if individual can distinguish two phonemes with one syllable words. Step 2: Use multiple syllable words to determine if individual can comprehend that two syllables can comprise one word	Reduce the pace of the speech being presented. Ensure distinct separations are made between words.
Speech & Noise		Request that the individual follows just one sound pattern in the presence of multiple distraction sounds	Reduce, & where possible eliminate, background noise or distraction
Attention			
Attentional Issues	Difficulty attending to target stimuli. Can be unfocused, or hyperactive (but not always)	Request that the individual completes a task which is outside of the main task (like touching his avatar)	Response times should be modified as necessary. Unnecessary sources of distraction within the learning environment should be removed where possible
Social, Emotional &Behavioural Difficulties			
SEBD	Psychological difficulties	Individuals with SEBD	Attempts should be made

	which can lie at the root of a variety behavioural problems – acting out (aggression, anger issues, deliberate rule defiance) or acting in (self-harm or depression). Typically, individuals with SEBD display issues with self-control of emotions and behaviour and experience a significant amount of emotional stress and distress.	display a low tolerance for frustration in the course of completing challenging activities. Attempts are made to avoid or escape particularly difficult or challenging scenarios. Behavioural observations might include an inability to follow instructions or maintain focus on single task and a notable impulsivity in their actions. While using technology, they may become annoyed or frustrated if the technology is slow. They may use the equipment in an inappropriate manner – may fail to display a willingness to wait for loading screen, may click on all of the onscreen items at once or in rapid succession. They display considerable distractibility in completion task, may continuously flick between windows and items. Poor focus and may not display the capacity to sustain their efforts and see a task through to completion. May be defiant, violent or become increasingly stressed as the task progresses.	to foster positive emotion through the experience of positive learning experience. Grading & assessment should be conducted at the appropriate standard so as to ensure that the student experiences goal attainment and instances of success. Certain levels within the application should have very achievable goals and should be relatively easy to complete. Clear reinforcement should be offered for positive on-task endeavour and the attainment of minor aims. Content should not be excessively emotive & the actions demanded of the individuals should not be overly aggressive or forceful. Learners should be allowed to step back to a previous easier level if they are beginning to become frustrated. Consistent prompts to stay focused upon the task should be offered, as should regular reminders of the objectives and desired outcomes. Learners should also receive regular reminders of the previous goals achieved to date.
Autism Spectrum Disorder (ASD)			
ASD	May have issues with social communication & interaction (may limit word usage and have flat tone).	Difficulty with interpreting widely used social cues. May have issues with switching tasks. Display	Instructions should be provided in an unequivocal & unambiguous manner. Instructions should also

	May display restricted and repeated patterns of behaviour and activity (hand flapping, finger flicking or rocking back and forth). Interests may be narrow and specific. Can become distressed if routine is broken or if they are in the presence of excessive or overwhelming stimulation.	repetitive behaviouramd have problems changing mid-stream due to the rigidity of their behavioural patterns. When using a screen, they may focus on one area of the screen and ignore or exclude stimuli appearing in other areas of the screen. Language (if they have language) is often formal & stilted. May display atypical responding. May have issues with being easily overstimulated & may display overreaction to sensory inputs. May complete repetitive and stereotyped behaviour upon the technological device.	be provided one at a time and a visual/pictorial representation of these rules should accompany any verbal or written instruction. Explanations of social cues should also be provided so as to construct a better understanding of social situations. Tasks should be set in graduated levels of difficulty. All sensory issues should receive consideration (hearing- volume control, sight – reduce distractions, reduce brightness). Caution should be taken to ensure that the learner is neither overstimulated nor understimulated. Allowances should be made in terms of content topic selection as by enabling the learner to select topic, it should lead to a boost in engagement levels. Pictorial representation of the required materials, and the sequence of the activities should aid with planning and organisation around the task. The markers of the beginning and end of the task should be clearly expressed throughout the course of the task. In order to combat issues around the selection of the salient information from the content, it is important to ensure that superfluous information is eliminated from the

			learning environment where possible. Equally, it is important to determine if certain presentation factors (brightness, movement, colour etc.) override the salience of the functional & social or emotional significance of stimuli &, thus, present stimuli appropriately in line with this hierarchical, tiered thinking.
Dyspraxia			
Dyspraxia	Eye-hand coordination difficulties	A target should be presented on screen to the individual and assessments should be made around the accuracy level and response time of their reactions.	The target objects in the learning environment should be made bigger in size. Also, the learner should be advised to keep their finger close the screen when engaging in responding upon the task.
Motor Control			
Motor Control	Delayed response	A target should be presented on screen to the individual and assessments should be made around the accuracy level and response time of their reactions.	Two step validation (selection & then validation).
	Inaccurate Response	Same as above	
	Hand Control	Hand movement should be tracked as the learner attempts to follow a straight line. Distance between the finger and the line should be assessed.	The size of the validation zone should be increased in order to aid the accuracy of responding.
	Construction Dyspraxia	The drawing of geographic shapes proves problematic. How square is it?	In order to aid these learners, a fading visual guide should be available on screen.
Dyslexia			
Dyslexia	Phonological Awareness	See Auditory Agnosia	
	Sequencing	Learners should be requested to follow an audio sequence or pattern in order to assess	Tap and spotlight feature should be added to the application's functionality to aid the tracking of

		the capacity to follow the passage in a logical order and also to determine if a full set of instructions can be followed	progress throughout a verbal passage.
	Visual search		
	Visuo-spatial attention	The learners should be assessed in terms of their visual span from a starting point in relation to flashing letters. Speed of responding should be monitored	
Dyscalculia			
Dyscalculia	Sequencing	Combination of number & quantity/ relationship between number & quantities	Use different representation of numbers (use groups of items to teach multiplication or addition)
	Counting		
	Working with limited memory		
	Number Symbols		
	Number Operations		

Table 2.

Beneficiaries of the Potential Learning Content Adjustments within the ALSo Project Mobile Application

Content Adjustment	*Beneficiaries*
Increase the size of target stimuli	All Visual Problems, Dyspraxia, Hand Control
Brightness Control	Visual Acuity (Correctible/Non-Correctible), Colour Problem,
Contrast Control	Visual Acuity (Correctible/Non-Correctible)
Separate target stimuli (Visual & Auditory)	Cerebral Visual Impairment
Scrolling On Screen Text	Eye Movement Disorder
Capacity to present All On-Screen Stimuli In Same On-Screen Location	Eye Movement Disorder
Fade Out the Background	Cerebral Visual Impairment
Fade In Target Stimuli One At A Time To Introduce Them	Cerebral Visual Impairment
Present Content on One Side of The Screen Only	Visual Neglect
Limit Distractions Where Possible (Consider All Potential Sources of Sensory Distraction)	Benefits All
Equalizer & Amplification	All Auditory Issues
Exaggerate the difference when noise is coming	Sound Localisation

from right or left (Auditory)	
Capacity to Alter The Speed of Speech Based Stimuli	Auditory Agnosia, Attentional Issues, ASD
Capacity to ModifyResponse Times	
Foster Positive Emotion through positive Learning Experience	Benefits All (Especially ASD, SEBD)
Grading/Assessment Should Be Conducted At An Appropriate Standard To Ensure Achievement is Experienced	Benefits All
Positive Reinforcement Offered Within The Task	Benefits All
Flexibility In Topic Selection To Promote Engagement	Benefits All
Instructions Should be Provided One at a Time	ASD, Attentional Issues, SEBD
Visual/Pictorial & AuditoryRepresentation of Rules toAccompany Written Instruction.	Benefits All
PresentStimuli in line with this Hierarchical, Tiered Thinking (Be aware of certain presentation factors that may override the functional & social/emotional salience of stimuli (eg. Brightness, Volume etc.)	Benefits All
Two Step Validation (Selection first & then Validation)	Dyspraxia, Motor Control, All Visual Problems
Size of Validation Zone Increased To Increase Accuracy	Dyspraxia, Motor Control, All Visual Problems
Fading On-Screen Visual Guide Available	Construction Dyspraxia
Tap & Spotlight Feature Available	Dyslexia - Sequencing Problems
Utilise Different representations of Numbers	Dyscalculia

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