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Inclusive, Adaptive Design for Students with Severe Learning Disabilities

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Abstract

Young adults with severe disabilities and learning difficulties (SLD) have very limited access to appropriate learning resources. Their unique individual needs and requirements prevent them from accessing traditional methods of online learning, and resources tend not to be age appropriate. The majority of SLD learners has difficulty accessing a computer with standard peripherals such as a mouse and relies on assistive technologies (e.g. switches) to do so. Each learner tends to have specific needs that must be addressed in order to provide an accessible and adaptive platform for learning. The aim of this research project was, with the assistance and support of the learners and their tutors, to design and develop an adaptable and inclusive online learning environment specifically catering for the needs of young adults with SLD. Each stage of development was prototyped and assessed in the college environment to ensure the needs of the learners were thoroughly addressed.

1. Introduction

The aim of the Portland Partnership project was to develop prototype ICT-based software and curriculum content to better meet the needs of adult learners with a range of physical disabilities and associated learning difficulties. The Partnership was funded as part of the European Social Fund's 'Equal' initiative which sought to develop innovative ways of ensuring participation in lifelong learning; potentially opening doors to the labour market. It was led by Portland College - a national specialist college in Nottinghamshire, England, for learners with physical disabilities and associated learning difficulties, and involved partners from Further and Higher Education, as well as the private sector. The University of Teesside was responsible for conducting an analysis of user requirements and designing and developing the

adaptive and accessible learning environment itself. This paper provides an overview of the project and its findings.

The rationale behind the project grew from a group of practitioners who were no longer prepared to accept inappropriate resources designed for mainstream learners. Its initial focus was to identify the needs of a diverse group of learners with disabilities and design specifically for their needs. Extensive prototyping, user-testing and dissemination activity demonstrated that this was the most appropriate approach.

2. Learner Characteristics

The specific target user group for the project were young adult learners from 16 years upwards at pre-Entry level [1]. The differing needs and requirements of these learners make it difficult to portray a typical learner, however DfES describe these students as being "capable of learning, but they will have profound intellectual impairments and will require very specialised teaching [2]."

The varying abilities and disabilities of this learner group suggest that each learner has unique needs in terms of accessing Information Learning Technology or learning itself. The characteristics of a learner with profound and multiple disabilities vary greatly from one learner to another, but may include:

- limited or no sight e.g. lack of depth perception or reduced visual fields
- limited or no verbal communication e.g. dysarthria
- learning difficulties e.g. low levels of literacy and numeracy (The learner may be learning to recognise individual letters of the alphabet or count to five.)
- physical disabilities e.g. poor or no fine motor skills or quadriplegia

The learners involved in the project were predominantly residents and day students at Portland College. All learners studied a range of basic skills and life skills, including communication, numeracy and

literacy and daily tasks aimed at increasing their level of independence. In all cases, the learners in the project stated that they wanted parity with their non-disabled peers and therefore felt that they had a fundamental right to access ICT-based resources and tools.

Coinciding with the project's inception, developments in legislation placed increasing pressure on educational institutes to be more inclusive, so that all learners, regardless of ability, were given the same learning opportunities. The legal requirements opened the gates to inclusive and accessible online learning for all learners, particularly those with severe learning disabilities. One of the main points in the Special Educational Needs and Disability Act (SENDA), 2001 stated that: "If a disabled person is at a 'substantial disadvantage', responsible bodies are required to take reasonable steps to prevent the disadvantage [3]."

Many of the learning resources targeted at learners with SLD were not age appropriate or compatible with assistive technologies, whereas there were many resources designed specifically for more common disabilities such as dyslexia. This was an issue which needed to be addressed as students with SLD had very specific requirements and were in greater need of these resources to enable them to gain basic skills.

The pre-Entry-level learners were also heavily reliant on pictorial symbols and images which were integral to their communication and general understanding of language. There are many different symbol sets available, and although there is no universal language, using symbols appropriately will aid the learner and give context to a word, phrase or scenario. Below are examples of three such symbol languages.



Figure 1. Widgeit Picture Communication Symbols



Figure 2. Widgeit Rebus symbols

The nature of the problems encountered by this group of learners had a direct impact on their ability to make use of online learning resources. The first barrier to electronic learning materials was access to the resources themselves. A combination of both physical and cognitive disabilities meant they may were unable to use standard peripherals such as a mouse and keyboard, and instead required the use of assistive

technologies such as switches and touch screens to operate a computer.

There was a paucity of standalone electronic learning resources, and little to no access to online learning materials for learners over the age of sixteen with SLD. Many educational software programmes did not meet the needs of these learners as the online and standalone resources available tended not to cater for their exact access requirements. Furthermore, a high percentage of the software that was accessible was not age-appropriate.

3. Exploiting the potential of online learning

Online learning environments now form a standard part of teaching and learning for Further and Higher Education students and practitioners within the UK. They provide opportunities for communication between learners and tutors, peer learning and access to course materials and wider resources. However, they remain largely inaccessible to those whose physical disabilities prevent them from using standard computer equipment, or to those with low literacy levels.

The project aimed to support and promote online communication and learning. A Virtual Learning Environment (VLE), therefore, suited the project as it would allow an 'anytime, anywhere' approach to using technology, learning and communication. Furthermore, such a system would also ensure that roaming profiles were used, meaning that a learner's accessing preferences would automatically be loaded upon login.

From the outset, the project sought to promote meaningful use of ICT. The online environment and learning materials were designed to promote basic ICT use, as well as the development of literacy, numeracy and communication skills. Appreciating that computer-based learning could be a highly motivational, flexible and enabling solution for many learners, not least those with disabilities, we questioned the use of ICT for its own sake and promoted it as a creative tool at the tutors' disposal, rather than as a substitute for good teaching..

4. Learner Profiles

Participating colleges provided an overview of the needs and requirements of this unique target audience. To meet with ethical requirements these were made anonymous. Much of this information was transferred to the design and implementation of the adaptive VLE to ensure accessibility and adaptability for each learner. Baseline observations formed a criterion of the needs and preferences of the learner in terms of

software requirements for delivery of appropriate learning resources.

Detailed profiles of each learner were created based on the information gathered from the college databanks and baseline observations. These unique individual profiles were created to provide specific access to the VLE for each individual learner. The information provided the students' preferences or access requirements which included:

- Personal Information:
 1. Name
 2. Photograph
 3. Email contact addresses
 4. Class/Tutor Group
- Layout and access requirements:
 1. Background colour
 2. Font colour
 3. Text
 4. Symbol Set
 5. Audio
- Access Device:
 1. Assistive Technology
 2. Scan Speed

The hypothesis for these learner profiles is that they ensured adaptability and accessibility for each user by meeting their unique needs, providing that the VLE could support them

By designing the VLE so that it could be tailored for each learner according to their profile, ensured it became adaptable to meet the individual needs and preferences of the target user group. The development of these learner profiles, with the aid of the information gathered from the baseline observations, also ensured that learners were able to have the screen display and layout of their choice, and also compatibility between the VLE and their preferred input device. Using their own personal information and choice of symbol set increased the personalisation of the interface yet further. An essential factor of the learner profiles was that, through the tutor tools function, tutors were able to use the information to monitor which learning materials each individual could access within the VLE. This was particularly important in ensuring that learners could benefit from individual learning strategies. It was hoped that the adaptability of the VLE would transfer to other learners in mainstream education regardless of whether or not they had a disability.

5. The design of an accessible learning environment

Research gathered from learner observations, baseline observations and focus groups with learners and tutors was carried out in accordance with the ISO

13407 standard (human-centred design processes for interactive systems): "Understanding and specifying the context of use, specifying the user and organisational requirements, producing designs and prototypes and carrying out a user-based assessment [4]." The data gathered from these interactions with the learners and tutors helped to form a catalogue of the specific functionality and entry requirements the VLE would need to encompass for it to be adaptable and accessible to the needs of these learners. This led to the development of the design criteria for the Portland Plus VLE, which included:

- Ensuring appropriate language was used for each learner i.e. options of symbols, symbols and text or text only.
- Compatibility with adaptive technologies for those unable to use a mouse or keyboard.
- Providing built-in audio and visual clues for additional learning support.
- Providing an adaptable interface in terms of screen layout, including the provision for font and colour adjustments in order to support those with visual impairments.

The criteria for the design ensured that the VLE would be adaptable so that it could be adapted to meet the unique needs of each individual learner.

The Portland Plus online environment met the needs of those learners with low literacy levels via symbol-supported text and speech output. Using the environment and its contents enabled users to become familiar with the standard navigation conventions associated with ICT-based materials e.g. using an 'X' to close a program down or using an arrow to indicate 'back'. In addition, everything could be operated using one or two switches as an alternative to keyboard or mouse, making it accessible to learners with poor motor skills.

The VLE contained the standard features found in most mainstream VLEs, including a secure login system, communication tools, timetable and access to tailored learning resources.

At every stage, learners and tutors were involved in the development of the project's outputs. Discussions about initial ideas, focus groups, and the trialing and evaluation of iterative prototypes all provided unprecedented opportunities for learner and practitioner empowerment and engagement. For example, learners stated that one of their major frustrations was not being able to log on to a computer more independently. This led to the development of the accessible login screen for our online environment, which was welcomed enthusiastically by learners and tutors alike.

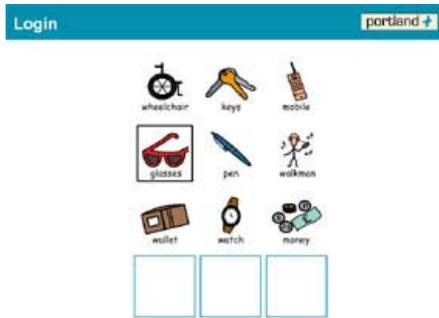


Figure 4. Login screen - Enter Password

The login process was an essential first point of contact for the learners. Learners were unable to log in themselves to any other system. It was important to make this process as accessible and autonomous as possible for the learner as this was the first step in independent online learning.

The input methods for navigation and selection included the development of a scanning mechanism for switch users. Single-switch users were given a scan bar - a coloured box that moved in a linear pattern from one symbol to the next within the display screen. The speed of the scan bar was controlled within the tutor tools function. When the scan bar was over the required symbol the learner used their switch to select that symbol. Two-switch users were able to move the scan bar in a linear pattern independently, by using one switch to move the scan bar and another switch to select the chosen symbol once it was highlighted by the bar. There was also a mouse input preference for mouse users and a mouse override for tutor intervention. The design ensured that it was also compatible with touch screens and most other assistive input devices such as tracker systems and head pointers.

As well as providing access to tailored learning resources, the VLE also offered a built-in symbols-based email system. The email tool was developed to offer learners the opportunity to send pre-determined sentences from a range of subject categories and topics via email to their peers and tutors. It was hoped that with further research that this design could be developed so that emails could be sent to external addressees with appropriate symbol translation and with interoperability with other standard email systems.

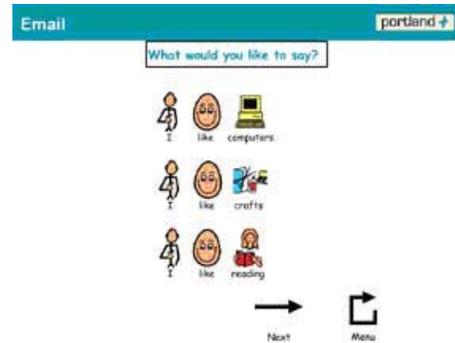


Figure 5. Email send - What would you like to say?

The timetable function was designed to display information in small, absorbable sections. As many of the learners were unable to understand or read the time, symbols representing periods of the day were employed to break up the daily timetable. Each timetabled activity was illustrated with an appropriate symbol as well as supported by text and audio. Should the VLE be developed further, more advanced learners may be given more detailed and expansive timetables e.g. a weekly table.

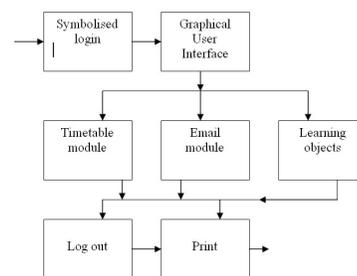


Figure 6. Overview of VLE learner interface

The tutor tools were an intrinsic part of the design and functionality of the VLE which ensured its adaptability and accessibility to Pre-Entry-level learners. These tools enabled a tutor to have complete control over what and how learners had access to within the environment. The tutor tools gave the tutor the ability to adapt the design and functionality to meet the needs of the individual target learners. The administrative tutor tools allowed the tutor to input all relevant information for each learner in a group, this included:

- Adding an individual learner to a group, which involved inputting details from the learner profile, comprising of:
 - Class allocation
 - Symbol set
 - Language level
 - Allocation of symbols password

- Selection of display colours
- Selection input device and settings
- Learner's photograph
- Audio requirements
- Class management
- Editing tutor details
- Allocation of functions/learning materials

At each stage of the design process, iterative prototypes were tested with the learners within the college environment. Participant observations were recorded onto video and transcribed and the data collated. These findings shaped the final VLE design.

6. Conclusions

The unique functionality and features of the VLE has resulted in an accessible and adaptable learning environment which meets the needs of learners with severe learning difficulties and physical disabilities. The design encourages a greater level of independence for the learner by ensuring that the VLE and the learning objects are accessible with the appropriate input device, language tools and layout required by each individual user. Independent learning through the VLE may encourage learner empowerment. Learners now have a gateway to more appropriate and accessible learning resources. Improved access to resources should further encourage independence and a willingness to use and explore the VLE features, which will potentially lead to an increase in academic attainment. The collaborative email tool offers an alternative means of communication and will support the development of communication skills which could lead to increased learner empowerment and independence. The flexibility and level of control within the tutor tools ensures the required adaptability and functionality of the VLE for its learners. This is a distinct benefit to all tutors as they have increased levels of monitoring and assessment over individual learners, thus ensuring that their academic and learning needs are met.

The current VLE specification has been designed exclusively for the lowest levels of academia - for

learners aged 16 years plus at pre-Entry. As the current design is tailored specifically to this target user group it may be inaccessible to other groups of learners with disabilities, such as those with severe visual impairment or blindness.

As part of the evaluation procedure feedback was taken from a sample of the target user group; responses included:

- "I like it reading out to me", Student A
- "I would like to send emails to my mum because I can't at the moment", Student B
- "I think it would be good for people with limited hand movement" student B
- "I did it all by myself" Student C

In order to claim that the VLE design is fully accessible to most learners up to and including those in mainstream education, it may require different interface designs for the front end and need to support other assistive technologies. However, developing an accessible VLE that can benefit learners with learning difficulties and/or disabilities may also benefit other users, as accessible software can often be the most usable software. The level of adaptability of the VLE to meet other learner needs (including those of the elderly) is an area that is hoped to be explored in future research.

7. References

- [1] DfES (2001) *Adult Literacy Core Curriculum including Spoken Communication*, London DfES
- [2] DfES (2000). *Freedom to Learn: Basic Skills for Learners with Learning Difficulties and/or Disabilities*. London DfES
- [3.] *Special Educational Needs and Disability Act 2001 (SENDA), Chapter 10* [online] Available from www.hmso.gov.uk/acts/acts2001/20010010.htm [Accessed January 2008]
- [4] *ISO/IEC. 13407 Human-Centred Design Processes for Interactive Systems*, ISO/IEC 13407: 1999.