Summary of the Special Thematic Session:

Inclusive Settings, Pedagogies and Approaches in ICT-Based Learning for Disabled and Non-Disabled People

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Abstract

Education should be considered a basic right, but many disabled people experience barriers in accessing it. Enablers to changing this include the use of technology, legislation and changes in attitudes. The focus of this session will be ICT-based learning technologies for disabled and non-disabled learners and the associated pedagogical issues which can act as barriers or enablers. In addition to computer based and multi-media learning technologies, mobile learning using smart phones and PDAs is now feasible. Disabled people may require access to both purely learning technologies and assistive technologies to obtain the full benefit from education.

Inclusive Settings, Pedagogies and Approaches in ICT Based Learning for Disabled and Non-Disabled People

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Abstract: This short paper introduces four very different papers on the use of learning technologies to support inclusive learning. It presents a brief overview of the Entelis Network which is supporting the session. It is introduced by a brief discussion of the barriers still experienced by many disabled people to education and employment and the potential of learning technologies to overcome some of these barriers.

Keywords: learning technologies, inclusion, disability, Entelis Network.

1. Introduction

Education is both of great value in itself and essential for accessing other opportunities, such as employment. It also increases the contribution people are able to make to society. While access to education should be considered a basic right, many disabled people still experience barriers to obtaining an education and employment and are in an enforced state of dependence, rather than being able to earn their own living and contribute to society.

Disabled people are still seriously underrepresented in both further and higher education, though their numbers are increasing [1]. Participation in higher education is potentially empowering to all students, but disabled students still experience a number of barriers to learning and participation and obtain

poorer degree classifications despite having comparable entry qualifications [2]. They also have lower average qualifications than the population as a whole [3] and considerably lower rates of employment. For instance, a 2001 survey for the European Blind Union found unemployment rates for blind people ranging from 55% in Finland to 87% in Poland [4]. Only an estimated 12% of 'higher functioning' autistic people are in paid employment [5] and only 25% of young autistic adults have any education or training after school [6]. Their employment rates in science, technology, engineering and mathematics are particularly low, with barriers resulting from the lack of meaningful access to learning materials and technologies. Disabled people earn significantly less than non-disabled people, with about half of them having incomes below the 'official' poverty line of less than half the national average wage and disabled women particularly disadvantaged [7]. They also are under-represented in professional and managerial occupations and disproportionately congregated in semi- and unskilled occupations although they have 'moved up' the occupational class structure since the mid-1980s [7].

2. The Potential of Learning Technologies

Overcoming these barriers will require a combination of different approaches, which target the underlying structural and collective issues [8]. The focus in this session is the use of learning technologies. Education has always used technology, from a stick for scraping letters and diagrams in the earth or sand onwards. However, the range, diversity and different media in which educational technologies can be developed are many times greater now than at any time in the past. Developments in ICT have the potential to transform teaching and learning. Existing innovative application areas include mobile learning e.g. [9,10], microlearning [11] games based learning e.g. [12].

It is important that learning technologies are used in ways that increase opportunities for disabled people rather than create barriers or a new digital divide. ICT both has potential advantages for disabled learners and raises issues of the

accessibility and usability of these technologies [12] and their match to the particular needs and learning styles of specific groups of disabled people. Accessibility is about the environmental characteristics of the system input and output which either enable or prevent particular groups of users from using the system, whereas usability is the ability of the system to carry out the intended function(s) when used by particular groups of users [13]. Thus, some (groups of) disabled people may require existing learning technologies to be modified or to use assistive technologies to access them and engage in learning tasks [14,15].

3. The Entelis Network

The session is supported by the Entelis Network (http://www.entelis.net/). It was set up with funding from the Lifelong Learning Programme of the European Commission with the aim of contributing to bridging the digital divide in Europe and worldwide through activities to support the acquisition of digital skills and the effective use of assistive technology. The project's networking activities focus on knowledge exchange and supporting policies to encourage the effective use of assistive technology and learning technologies to overcome some of the barriers to participation in education experienced by disabled people. Specific initiatives have included living labs, the active participation of end-users and knowledge sharing events such as seminars, project development workshops and policy development studies. Project stakeholders cover a wide range of individuals and organisations, including disabled people of all ages, their assistants and carers, educational organisations, researchers, policy makers and assistive technology developers and suppliers.

4. Session Papers

The session consists of four papers which use different learning technologies to support inclusive learning for different user groups. Haptic models of arrays through 3D printing for computer science education by Nicola Papazafiropolos, L.

Fanucci, B. Leporini, S. Pelagatti and R. Roncella, Università di Pisa and ISTI CNR, Pisa, Italy, involves the use of 3D printed haptic representations to support blind students learning about computer science data structures and algorithms. A simple, but general framework was presented for use with both visually impaired and sighted students. The model has been evaluated by small numbers of sighted and blind students who found that the approach helped them learn about arrays and sorting algorithms. Further tests with sighted students showed that they were able to describe the algorithms in their own words and carry out the given tasks. The authors plan to carry out more extensive tests and adapt the approach to graphs and trees.

Tablets are a popular technology which is increasingly being used in education. This raises issues of whether tablets do indeed have educational benefits and appropriate ways of using them to ensure that they do improve educational outcomes. Efficacy of tablets for students with learning difficulties studying concepts in geometry, Betty Shrieber, Kibbutzim College of Education Technology and Arts, Israel, examines these and related issues through a study collecting both quantitative and qualitative data on the use of tablets to support learning geometry with three students performing below the class average level. Outcomes were positive with regard to improvement in performance and student enjoyment. There were also indications that the multi-sensory approach made understanding difficult subject matter easier and that the apps introduced a 'play' element to learning. However, further studies will be required with larger numbers of students.

Using biometrics to support affective elearning for users with special needs, Ian Pitt, Katie Crowley, University College Cork, and Tracey Mehigan, Trinity College Dublin, Ireland, discusses the use of sensors to obtain data on learners' emotions and behaviour to assess individual learning styles and support the development of more affective and effective learning systems. The paper presents a comparative study of the emotive elements of learning of dyslexic and non-disabled students obtained from biometric data. While there is some potential in using this type of data to help learners determine the circumstances in which they learn best and realise how much their concentration is reduced

when they text in class, there are also very serious associated ethics, privacy and data management issues. This relates both to who will have access to the data and how it will be used.

Designing effective learning technologies for autistic people, Marion Hersh, University of Glasgow, Scotland investigates the current state of the art in the area of learning technologies for autistic people. The focus to date has been on technologies for autistic children with little aimed at adults and therapeutic e.g. emotion recognition rather than academic or wider learning. The paper discusses autism in terms of the social model of disability and neurodiversity rather than the more common deficit approach. Recommendations include the needs for a focus on strengths rather than deficits in learning technology design, technologies designed for adults and technologies with a focus on academic and wider learning rather than therapy, as well as the development of technologies with easy customisation features to allow adaptation to the user, particularly with regard to sensory issues and special interests. There is also a need for the development of methodologies for involving autistic children and adults in the design of learning (and other) technologies.

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Designing Effective Learning Technologies for Autistic People

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Research question or challenge addressed:
- What is the current state of the art in learning technologies for autistic people?
- What factors should be taken into account in designing learning technologies for autistic people?
- How can autistic people best be involved in the design process?

Brief overview of the work and the main outcomes
- A number of learning technologies have been developed for autistic people, but most of them are for children, with little available for adults.
- Many learning technologies for autistic people focus on therapeutic rather than academic and wider learning applications.
- End-user involvement through survey of autistic women; questionnaires on educational games and to Polish teachers and other educational professionals working with autistic students; and the author's reflections and insights based on her own experiences as an autistic.

Lessons learned, particularly those related to student empowerment
- Focus on strengths not 'deficits' in technology design, using an understanding of autism based on the social model of disability.
- The need for easy customisation to adapt to the particular learning and take account of sensory issues and particular interests.

- The need for appropriate methodologies to support the participation of autistic children and adults in learning technology design and the importance of not making restrictive assumptions or oversimplifying procedures, which providing appropriate support.

Recommendations for further research or activities
- Survey of learning technology requirements of autistic people
- Development of improved methodologies for involving autistic children and adults in research e.g. drawing on AASPIRE approach of co-research between autistic self-advocates and academic researchers.
- In-depth evaluation of existing learning technologies for autistic people and design for all learning technologies.

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Haptic models of arrays through 3D printing for computer science education

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Research question or challenge addressed:

- What is the current state of the art in computer science education for visually impaired people?
- Can 3D printing be used in order to build haptic models than can be used as assistive device?
- Is it possible developing a general method that can be used by the teacher to introduce data structures and algorithmic thinking to both visual impaired and sighted students in inclusive classes?

Brief overview of the work and the main outcomes

- There are several examples of using 3D printing in education, for visually im-paired students, but it was rarely proposed in computer science.
- We developed a simple but general way to represent data structures, i.e. 3 D printed haptic models for reproducing arrays and their application to algorithms.

Lessons learned, particularly those related to student empowerment

- A short evaluation conducted with both visually impaired and sighted students was successful and encouraged us to better investigate the benefits of using 3D printers in this field.
- The blind users who participated to the experiment declared that haptic models made it easier the understanding of arrays and sorting algorithms much easier.

- Educational games tested with sighted students showed how our haptic models can be suitable to teach basic algorithmic thinking to both blind and sighted students

Recommendations for further research or activities
- Evaluation of the method in a realistic case study with inclusive mainstream classes.
- Adapting it to other data structures, such as graphs and trees in order to cover all topics of high school computer science curriculum.

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Using Biometrics to Support Affective eLearning for Users with Special Needs

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Research question or challenge addressed:

- Can learning experience/learning outcomes be improved by tailoring learning delivery to suit the individual, based on data gathered using biometric techniques?
- Can this approach be used to help learners with special needs?
- Is it possible to gather the necessary data using cheap, widely-available biometric technologies such as those now standard on many smartphones, tablets, etc.?

Brief overview of the work and the main outcomes

- Affective computing uses (e.g.) cameras to capture facial expressions, microphones to capture speech, and other sensors to capture physiological data such as skin temperature, galvanic resistance, pule-rate, etc.
- Many smartphones, tablets, etc., include biometric technologies as standard (e.g., for fitness monitoring), removing the need to use specialist hardware.
- Data gathered using cheap, widely-available biometric technologies generally correlates well with data gathered using laboratory biometric techniques.

Lessons learned, particularly those related to student empowerment

- Previous work has shown that it is possible to assess learning-style using biometric techniques (as opposed to questionnaires).

- It has been shown that certain learning styles are more commonly found among certain groups of special needs learners.
- However, little work has been done to assess whether identification of learning-style differences can be used to help special needs learners in the same way as with mainstream learners.
- This work centres on dyslexic learners, comparing assessments obtained using traditional questionnaires with those obtained using biometric techniques.
- The affect of the assessment method (questionnaire or biometrics) on the subjects is also measured.

Recommendations for further research or activities
- Existing work is based on small samples; more work is needed with larger groups in order to obtain definitive results.
- Variations in assessment technique (compounded by the small size of the subject pool) make it difficult to focus on particular categories of dyslexic learner; more tightly-standardised assessment techniques are needed.

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Efficacy of tablets for students with learning difficulties studying concepts in geometry

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Research question or challenge addressed:
- Is a multi-sensory teaching through "tablets", promote skills recognition and measurement of geometry with students with learning difficulties?
- The study goal was an investigation into the efficacy of tablets as teaching tools for students with learning difficulties attempting to study concepts in geometry.

Brief overview of the work and the main outcomes
- The learning process indicates an increase in achievements by each student as they began using tablets.
- Analyzing of multiple baseline data (Single Subject Design) reveals a great degree of baseline variation without tablets, and more moderate and stable variation during intervention.
- All students claimed they enjoyed classes and study applications more with tablets, which gave them confidence.

Lessons learned, particularly those related to student empowerment
- It seems that the use of various apps made the students feel like they were playing and not "studying".
- Multisensorial learning using tablets allowed these students to understand the subject matter better, which had been difficult for them previously.

- Pressing the app icons instigated immediate reaction as the students followed instructions and thus prevented difficulties in task initiation.

Recommendations for further research or activities
- The more teachers enjoy the creativity made possible with tablets, the more "contagious" their enthusiasm becomes to the students.
- We recommend continuing this research with other populations of people with specific learning disabilities to examine the efficacy of tablets in learning.
- We recommend allocating technological resources that can provide students with experiential learning tools in a manner that can be adjusted to their individual personalities and needs.

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The **ENTELIS** project is co-funded by the European Commission. We work to help reduce the digital divide by fostering the development of ICT skills of persons with disability and the elderly and increasing their ability to use ICT-based assistive technologies.

We also aim to facilitate the development of strategies to bridge the digital divide, by creating a sustainable network solidly embedded in existing European umbrella organisations, such as AAATE, EASPD, EVBB.

The consortium has produced an extensive State of the Art report of which this Manifesto is a reflection.

Join us. It is worth it!

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