Twenty five years of training and education in ICT Design for All and Assistive Technology

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Abstract. Over the last twenty to twenty-five years 'Design for All' principles and practices including Assistive Technologies have been collected into formal and informal courses which have been used to train designers of Information and Communication products and systems. The aim of this paper is to describe the relevant changes occurring in training and education in the design and use of technology.

The development of courses and materials has been supported by a number of EU funded initiatives including HEART, DAN, IDCnet and Design for All@eInclusion. In addition there have been individual responses to the demands for training courses in higher education and we include five case studies from around Europe: Greece, Austria, Czech Republic, Norway and UK. These show what can be achieved and act as beacons for continuing progress.

EU and national initiatives to support digital inclusion are trying to address the needs of all those who are subject to social disadvantage as a consequence of age and disability as well as other factors such as low educational achievement, poverty and living in remote rural areas. Applying Design for All principles offers the opportunity of designing systems that are better matched to the existing needs of those who are technologically disadvantaged. However progress towards developing more specialist courses or more fully integrated Design for All principles in mainstream technology courses remains slow. The latest initiatives include the development of a curriculum for professional training and this offers an important alternative educational route, adding knowledge of Design for All to those with established technical skills.

Keywords: Assistive Technology, Design for All, higher education, inclusive design, product design, universal design

1. Introduction

Over the last twenty five years the use of information and communication systems and technology has increased dramatically and the effect on real peoples' lives cannot be underestimated. The use of mobile and fixed technology information and communication technology is now a normal part of the majority of Europeans population, as people have become familiar with emailing and moved on to social networking tools such as Facebook, learned to use the internet including Google and Wikipedia, and started downloading music films and watching TV on their phones, tablets and laptops [1]. In addition there is increasingly an assumption that people should be able to participate in a wide range of formal activities such as eGovernment, eHealth and eEducation via their computers and mobile phones.

The increased demand for access to Information and Communications Technologies (ICT) has resulted in

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Table 1
Timeline of European initiatives in Design for All and AT education

Action	Date	Context
New design for old	1986	Exhibition on design for older people
Human Computer Interaction courses include design for All, University of Crete,	From 1993	Courses: Design for older and disabled people include in elements of mainstream computing courses.
TIDE: Heart project	Published 1994	Project: Design of Assistive and Rehabilitation Technology curriculum
Design for Ageing Network	1994 to 1997	Project: Product design and inclusive design in relation to older people. The project produced a teaching pack.
University of Linz, Institute of Integrated Study	From 1994	Courses: Design for disabled people and assistive technology include in elements of mainstream computing courses. Barrier free web design
IS4ALL training course	1999	Project: Universal access into a software development life cycle.
GENIE	1998 to 2001	Project: Education network providing curriculum guidelines for HE in product design with respect to aging and teaching materials.
CATA Certificate in Assistive Technology Applications University College Dublin	1998–2006	3rd level course for professionals and end users in partnership with Central Remedial Clinic
TELEMATE demonstrator projects 2000	1998 to 2001	Project: Assistive Technology and Rehabilitation training
User Interfaces for All	2001	Book: Mainstream human computer interaction and design for all
DACA – Diploma in Assistive Technology applications University College Dublin	2002–2006	3rd level Diploma for professionals and end users who had also completed the CATA course in partnership with Central Remedial Clinic
IDCNet	2002 to 2004	Project: Developed Curriculum framework in design for all in ICT
EDeAN	2002 continuing	Network formed as part of eEurope 2002 Action PlanIDCnetwith over 160 members in 24 countries
DfA@eInclusion	2007 to 2009	Project: Professional knowledge for mainstream design for all education and training
The Universal Access Handbook	2009	Book: Updated mainstream human computer interaction and design for all
Masters in Computing and Assistive Technology Dublin Institute of Technology	2008–	A Masters program developed in collaboration with the Centre for Excellence in Universal Design in the National Disability Authority to inform professionals in the ICT field about AT and Universal Design
Masters programme: Digital Inclusion Middlesex University, UK	2010	Course: computing/design mainstream
Masters course: Universal Design and ICT University College-Norway	Future	Course: design, mainstream

an increased need for designers and educators to understand the needs of all the potential users of these systems, including older users and those with disabilities who have not yet engaged with these technologies and who encounter serious challenges in doing so. The need for accessibility knowledge to be presented in mainstream ICT technology courses is a critical key to the success of digital inclusion policy [2].

Over the last twenty-five years there have been a number of European initiatives which have aimed to raise awareness of the issues and benefits of developing systems that meet the needs of older and disabled people. Three different disciplinary approaches have worked separately and together to address the issues of educating students who will have the necessary skills and knowledge to design systems that support the needs of older and disabled people and which are inspired by those needs. These three disciplines are drawn from rehabilitation and Assistive Technologies (AT) which have specialist knowledge of disabled people, Prod-

uct Design (PD) with an emphasis on innovation, and from computing especially Human Computer Interaction (HCI). Knowledge from these three areas have combined together to form the base of Design for All (DfA) practice.

Individual universities in Europe have put these initiatives into practice, developing new courses and materials. The most recent developments have been further responding to the issues of social exclusion which can be caused by a lack of access to digital technologies. This exclusion can affect not only older and disabled people but also socially disadvantaged people affected by financial, educational, geographic and other factors. The timeline (Table 1) highlights a number of significant activities and initiatives commencing from 1983.

These European initiatives need to be considered against a background of rapid technological change and the introduction of new services. For example, the first course in Human Computer Interaction in Greece

in 1993 was started two years before Microsoft first gave away Internet Explorer as part of Windows 95 in 1995. The first Web Content Accessibility Guidelines (WCAG 1.0) were published in 1999 and revised (WCAG 2.0) in 2008. Searching for information changed rapidly following the launch of Google in 1997 and Wikipedia in 2001 while Facebook in 2004 changed the way people connect. The launch of the first iPhone in 2007 has brought further changes in interface design and expectations of mobile service applications.

2. Initiatives from product design

The defining date for the start of the innovation in thinking around design for older people, especially in terms of education and training in the UK, was 1986. This was the year of the ground-breaking exhibition held at the Victoria and Albert Museum in London, entitled New Design for Old. This signalled the way forward for a complete change in attitude and understanding of the needs of older people and led not only to a greater awareness of the need to design 'inclusively' and for our products and communications to be accessible, but also to put the user at the centre of the design process and to design 'with' rather than 'for' that person.

2.1. The Design for Ageing Network (DAN 1994–1997)

The Design for Ageing Network (DAN), together with the later creation of the Design Age project at the Royal College of Art, UK were two of the most influential initiatives which emerged from the New Design for Old exhibition. DAN was founded in 1994 by Professor Roger Coleman with the aim of bringing together from across Europe a range of people committed to ensuring that mainstream design took account of the needs of older people, and to research and share findings on an international basis and to encourage industry and commerce to recognise the economic potential of products/services for older people. DAN was welcomed throughout Europe and from a range of organisations – voluntary, academic, policy and business – and representatives from fourteen countries joined. DAN was instrumental in launching a range of special initiatives [3]:

– A touring exhibition aimed at the general public which focused on raising awareness and the profile of designs for older people and how design could improve quality of life. The exhibition was designed so that hosts could add their own, local material which increased the content of the overall exhibition as it moved forward.
– An Education Group which aimed to raise the profile of these issues within tertiary education and led to a Teaching Pack appropriate for pan-European use.
– Sharing case-studies of best practice in education and skills which led to an Intensive Summer Programme in Gerontechnology (funded by the ERASMUS programme run by the European Commission) running at Eindhoven University over a number of years.

2.2. The Gerontechnology Education Network in Europe (GENIE 1998–2001)

GENIE was established in January 1998 in order to create a network through Europe of organisations interested in improving and originating material on technology for older people – called gerontechnology – and also raising the profile of the subject so that it would become a mainstream subject throughout Europe. The Network lasted until August 2001 and over the course of that time, it produced a web-based learning map for teachers and students, a library of useful case-studies and a learning pack and curriculum guidelines.

The final meeting held in Helsinki consisted of a number of workshops spanning different age groups and disciplines. The purpose was to provide an experimental and learning opportunity enabling students to work directly with older people in all stages of the design process. The workshop procedure and results were written up in a paper: 'GENIE Workshops for Curricula with User Involvement and Inclusive Design. The project was led by the Technical University of Delft [4].

3. Initiatives starting from Assistive Technology

Assistive Technology focuses on supporting the needs of disabled people through the design and use of technology. It has a long history, which in Europe led to the formation of the Association for the Advancement of Assistive Technology in Europe (AAATE) in 1996. Two projects, HEART and TELEMATE brought together specialists in Assistive Technology from across Europe to develop education and training of professionals and beneficiaries.

3.1. The HEART Project (1993–1995)

The TIDE funded HEART project produced publications that were designed to meet the educational needs of Rehabilitation Technology and Assistive Technology (RT/AT) specialists and related professionals [5]. This project conducted a survey of existing training programmes, and identified training requirements for the various professionals and critical components for a European curriculum. The curriculum contained technical components as well as of human and socio-economic elements. One of the technical components included was communication which covered interpersonal communication, telecommunications, user interfaces, computer access and multimedia. The HEART study also promoted the Design for All approach in the recommendations of lines D and F. This work identified many of the key elements which have gone on to become critical to Design for All education and training. Many of the issues have been taken up and further developed by projects and initiatives after the study.

3.2. The TELEMATE Project (1998–2001)

The European TELEMATE project made use of the results of the previous HEART work. It was set up to codify and publicise the basic knowledge required by professionals working within the field of Assistive Technology. It made use of telematics to store and transmit that knowledge. It produced two example distance teaching and blended learning courses, one on fundamentals of AT, the second on computer access. By using the latest technology to transmit information on current developments and best practices it served to raise the knowledge level of the Assistive Technology professional and to provide a better quality of service to the end user.

The aims of TELEMATE were that disabled and elderly people should be given better awareness and understanding of AT and its benefits, quicker implementation of new developments, and better-informed and integrated services from providers.

The TELEMATE project identified the fact that usability and accessibility issues were still missing from many technical curricula in ICT engineering. The TELEMATE project concluded that education has a long-term role in changing mentalities within society generally. A comparison was drawn with the shift in overall attitude towards ensuring all buildings were made accessible to disabled people. It suggested that the same shift was needed for telecommunication services and equipment [6].

4. Inclusive design curriculum network

The aim of this network was to integrate information and identify core knowledge and skills for model curricula in Design for All (or inclusive design) specifically for ICT products and services. The network ran formally from August 2002 to May 2004 and evolved into an initial support of European Design for All e-Accessibility Network (EDeAN). Specific outcomes emerged from both tutor and student perspective: new teaching materials, modules, and courses on inclusive design. The aim was to create a new generation of professionals capable of designing for all.

The European Commission supported EDeAN by way of its IST thematic network, D4ALL Net and currently continues to support work in this area and to share relevant knowledge.

4.1. Defining the required knowledge and skills (IDCnet 2002–2004)

The IDCnet project classified the knowledge and skill sets necessary to design Universal Design curricula, after thorough research on existing initiatives and interaction with interested parties including higher education institutions and industry [7]. The key sets identified were:

- Design for All (DfA) Awareness – to understand how barriers are unintentionally put up when user needs are not sufficiently understood, and to understand that DfA does not mean design for disabled, but for diversity of users and contexts.
- Why Design for All? Ethical, legal and commercial considerations – as part of ethical considerations, students learn about, the move from segregation to integration, from specialized solutions to inclusive solutions and equal opportunities for all. As part of legal considerations, students learn about various pieces of legislation.
- Recommendations: Principles, Guidelines, Standards, Best Practice – students are made aware that such bodies of knowledge exist and are encouraged to search for such work and consult the relevant ones.
- Interpersonal Skills for Teamwork – communication skills including information representation, requirements gathering are very important to design work practice in general and to Design for All in particular.

– Accessible content: knowledge about documents and multimedia – the emphasis is on making sure that 'content' (mostly information and interactive Web pages) is accessible and usable.
– Accessible interaction: input and output – includes different types of modalities (speech, haptics, gesture, sketch, force feedback, scanning, bio-sensors, etc.) in both HCI and AT.
– New paradigms of interaction – this category was to be a place for the work that is mostly in research state currently, but could breakthrough into mainstream development.
– User-centered design – human computer interaction methodologies and techniques.

5. Developing a European curriculum

5.1. Design for All @ eInclusion (2007–2009)

The development of training and educational material and courses was further supported by the Coordination Action funded by the European Commission, under the Information Society Technologies Programme, in the context of Framework 6. Design for All @ eInclusion was supported by EDeAN and involved 23 European partners. There core objectives of this project included the further development of curriculum guidelines to support the development of new courses and programmes which integrate Design for All principles and practices.

An initial survey in 2007 revealed few teaching programmes within ICT related education that offer the core topics of Design for All in ICT as previously identified by IDCnet framework. However, this survey, which was conducted by the European partners identified a number of instances of small elements, single modules and seminars. These examples have contributed to the development of curriculum guidelines which aim to stimulate the creation of new specialist programmes – especially at Masters level and to encourage full integration within current mainstream ICT education and training. Suitable criteria, structures and content for the creation of both on-line and off-line courses for Design for All for eInclusion, were created in this project by educational and professional bodies throughout Europe. The courses were designed to meet the needs of a wide range of stakeholders e.g. designers, business executives, user groups, undergraduates (modules) and post graduates (MSc degree level).

There is also a need to provide training to active engineers in different aspects of Universal Design. This training must be tailored to different types of users typically found in industry from managers to programmers, and with different levels of granularity. The taxonomy of topics listed for higher education institutions was adapted to the industry needs under the scope of the project [8,9].

6. Example case studies of design for all in Europe

6.1. Case study one, Greece (1993 to current)

Over the past two decades, the Centre for Universal Access and Assistive Technologies of ICS-FORTH and the Computer Science Department of the University of Crete, Greece have developed education and training material for DfA in ICT.

The Computer Science Department of the University of Crete addresses topics related to DfA in two courses, run since 1993, one at an undergraduate and one at a postgraduate level. The "Human-Computer Interaction" course, offered to undergraduate students, includes two introductory lectures on DfA. The "Advanced Topics in Human-Computer Interaction" course is offered to postgraduate students. The course is mainly about DfA, touching upon many related topics such as user-centred design, e-accessibility, universal design principles, adaptive interfaces, alternative interaction techniques, evaluation methods, examples of good practice, design for older users, design for children, design for cognitive impairments and Ambient Intelligence environments.

Teaching at the University of Crete and elsewhere has benefitted by two publications, most recently "The Universal Access Handbook" [10], which followed up "User Interfaces for All – Concepts, Methods, and Tools" [11]. "The Universal Access Handbook" reflects recent developments the field of Universal Access in ICT in an effort to consolidate present knowledge in the field and open new perspectives for the future. The Handbook provides a structured guide to professionals and practitioners working in the field, and an important educational tool in an increasingly globalized research and development environment.

Various past projects of ICS-FORTH have supported training in DfA. For example, the IS4ALL project (IST-1999-14101) was the first Thematic Network, which addressed in a systematic manner the task of consolidating and codifying available knowledge on univer-

sal access (in the context of Health Telematics) and developed an online training course on DfA.

Training activities in ICT and DfA have been conducted also in the context of the Greek national project "Eftehnos" (2003–2005). The project aimed to develop a human network among academic/research partners, companies and organizations of persons with disabilities, aiming at promoting awareness and proficiency of the scientific, research and business environment to the use of new supportive technologies.

6.2. Case study two, Austria (1994 to current)

At the University of Linz the Institute Integrated Study made several efforts to advance education in Assistive Technology (AT), eAccessibility and Design for All (DfA).

First of all courses have been integrated for mainstream study courses like computer science, business informatics and other related fields since more than 20 years [12]. Further on, AT, eAccessibility and D4All have been introduced in lectures in a number of courses at teacher education institutions, both addressing mainstream teachers and special teachers for students with disabilities [13]. The experiences in these courses clearly outlined a lack of in depth professional knowhow and a growing demand in practice. End users are skilled in using AT/ICT and expect up to date services and education. The ICT/AT progress, the growing demand by end users and the growing awareness of service providers led to projects setting up specialized courses.

In 2000 the development of two university courses started, supported by national and EU-projects [14]. One course focused on AT and one on accessible web design.

These courses have not so far been accepted as master courses so far. This outlines the biggest challenge regarding establishing in-depth education. Although there is a clear need and interest in the field, the demand for academic courses from students is low. Interviews with students have shown that there is interest in master studies but not so much in academic courses. It is the challenge at the moment to overcome this "chicken and egg" situation. Interviews with potential employers, both coming from mainstream and specific organisations, outlined that AT, eAccessibility and D4All are still recognized more as an "add on" to existing profiles than as a standalone profession. Specialists in this domain seem not to fit into day to day practice and

organizations do not (yet) see or are not (yet) ready to change internal workflows accordingly [15].

The University of Linz has set up an interdisciplinary master in Web Sciences [16]. Students with different backgrounds (technical, legal, economic and social) are invited to study this interdisciplinary course. Following introductory ("bridge") courses they can focus on specific aspects of web sciences. AT, eAccessibility and D4All are not offered as one specialized module but as aspects (courses) in all four domains. Thereby it is also expected that AT, eAccessibility and D4All find their way back into the traditional mainstream courses.

As a further initiative the institute in cooperation with the Austrian association [17] plans to study and analyse mainstream curricula to determine:

a) if they are relevant for AT, eAccessibility and D4All and
b) if they respect these topics and how they might be improved.

This should lead to a political campaign and recommendations to reflect and integrate the changing understanding of disability and aspects of AT, eAccessibility and D4All into the cur-ricula. Curricula are seen as an expression of acceptance and importance of issues in society. Better connection with AT, eAccessibility and D4All should help to improve awareness and implementation.

6.3. Case study three, The Czech Republic

During the last two decades the education in engineering in the Czech Republic has changed in its content rather radically. But there are still remaining barriers between disciplines and sometimes between individual courses. Introduction of interdisciplinary education needs a lot of personal engagement of involved teachers to persuade their colleagues that it is the right way for the future development of applications, especially aimed at support of people's life.

Several universities offering education in information science and technology provide courses on user interface design, in which some aspects of DfA are discussed. However, they do not consider the problems of disabled persons in their breadth and variability. It was therefore decided to develop a series of courses that will fill the gap in the education. The courses will become a core of an interdisciplinary study branch in Master study and life long learning.

6.4. Centre for assistive technologies project, Czech Technical University, Prague

This facility will serve for practical project-based education of students in AT. The courses will become a core of an interdisciplinary study branch in Master study and at the same time they will be offered in life long learning. The core courses cover the following topics: data sensing and transmission; sensors, security and control in assistive environment; circuitry and system principles of electronic devices for AT; advanced methods of data mining and knowledge discovery and their applications in AT; telecommunication equipment and systems for AT; multimedia technology. The topics are systematically and logically interconnected. The content is designed in such a way that theory, applications and system integration are represented in suitable proportion.

The Centre will serve as a platform both for education and for applied research in the area of ambient assisted living. The main idea is to offer space for development of integrating solutions.

6.5. Case study four, UK (2010)

In the UK there are a number of instances of DfA being integrated into mainstream courses in computing. The MSc Digital Inclusion was developed as a specialised course at Middlesex University to meet the need for ICT professionals who were working in the field of Design for All to study for a recognised qualification. Work was carried out on the development of the course curriculum with the European partners of the Design for All for eInclusion (DfA@eInclusion) project.

During the validation process support for the for the Masters programme came from a number of interested groups in the UK including national disability charities and politically by the then Deputy Minister for Digital Inclusion, Rt Hon Wayne David MP.

The MSc Digital Inclusion course is the first of its kind to be offered in Europe, having a focus on the inclusion of socially disadvantaged people as well as ageing and those who are disabled. The programme addresses the highly technical elements of digital inclusion and facilitates an interdisciplinary approach to Digital Inclusion. This 90 ECTS course includes modules on standards and legislation, accessible web design and user experience and inclusive design. The course is aimed at people already working in inclusion and accessibility as well as recent graduates, and it is offered part-time using distance learning tools. The first student cohort began their studies in Autumn 2010.

6.6. Case study five, Norway (2011)

Norway has adopted the "universal design" terminology to refer to the design for all. A new anti-discrimination act states that "all new ICT systems targeted at the general public must be universally designed by 2011 and all such existing systems must be universally designed by 2020". The Ministry of Children, Equality and Social Inclusion are responsible for the legislature and have taken several initiatives to establish national guidelines that are currently works in progress. In 2003 the Ministry of Education and Research established Universell the Norwegian national coordinator of accessibility in higher education.

Universal design is incorporated as fragments into various courses nationally, such as single lecture topics in courses on human computer interaction, in design courses and in library sciences. At Oslo University College, a 10 ECTS course called Universal Design, has been offered since 2008 with a focus on the universal design in ICT specifically. It is a compulsory module for all undergraduate students studying applied computer science. The goal of the module is to widen students understanding of the diversity among users and that there are many ways users access ICT.

Currently, Oslo University College has submitted an accreditation application for a master specialization entitled "Universal Design and ICT". This two year 120 ECTS master focuses on the design of accessible user interfaces, diversity of users and the underlying technologies. It is aimed at students with a technical background. The programme is partially founded on standards, legislature, guidelines and best practices, but also focuses on cultivating the students as active contributors of knowledge moving the field of universal design and ICT forward through research and innovation.

Outside the higher education sector the accessibility consultancy company MediaLT has in partnership with interest organizations developed a national Universal ICT certification run as a distance education course targeted especially at web designers and other ICT professionals who need to document knowledge of universal ICT.

7. Conclusions

This paper has shown some of the positive contributions in which this knowledge has been structured, created and transmitted to future professionals. This has resulted in a number of examples of quality teach-

ing on specialist and mainstream courses to interested students. Direct hands-on experience of novel HCI methods and techniques addressing users' diversity and awareness of the complexity of the domain has shown to have most impact on the students learning about DfA.

The need for increased knowledge about user requirements and user oriented design based on diversity has been acknowledged over the last twenty five years. Several initiatives have implemented parts of the recommendations on education of the HEART study. The need for Design for All knowledge to be present in education including mainstream ICT courses has been widely understood. The recent introduction of the curriculum guidelines for non-academic courses means that the DfA requirements within industrial training are being extended to meet the needs of established technical specialists.

As shown in the various projects and case studies reported here, DfA knowledge is still not taught on the majority of mainstream ICT courses and it is apparent that students and employers are not demanding its introduction. Further work is therefore required to emphasise the benefits of DfA to the users and creators of technology and to ensure that this training develops in parallel to the changes in technology such as the growth of the Internet.

Digital inclusion policies are drawing attention to the 'missing 30%' who are currently excluded and the need to ensure the rights of all citizens to participate in and benefit from these new opportunities. This missing 30% embraces social, economic and political disadvantage as well as issues of ageing and disability. The established principles and practices of Design for All offers an opportunity to ensure that designers and developers working in ICT related fields are able to respond to the challenge of creating new systems, services and technologies that meet these broad demands of digital inclusion.

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