

Inclusion4EU: Fostering Inclusive Technological Thinking for Software Design and Development

Dympna O Sullivan^a [0000-0003-2841-9738], Emma Murphy^a [000-0001-6738-3067], Andrea Curley^a [0000-0001-9412-8512], John Gilligan^a [0000-0002-4624-1833], Damian Gordon^a [0000-0002-3875-4065], Anna Becevel^a [0000-0001-7704-8975], Svetlana Hensman^a [0000-0002-1804-2925], Mariana Rocha^a [0000-0002-9242-3080], Claudia Rivera^a [0000-0003-4226-9262], Michael Collins^a, J Paul Gibson^b [0000-0003-0474-0666], Gordana Dodig-Crnkovic^c [0000-0001-9881-400X], Gearoid Kearney^d and Sarah Boland^e [0000-0002-9857-6977]
^adympna.osullivan@tudublin.ie

^a*School of Computer Science, Technological University Dublin, Dublin, Ireland*

^b*INFormatique., Telecom SudParis, Paris, France*

^c*Mälardalen University. Västerås, Sweden*

^d*Center for Smart Aging, Kerry, Ireland*

^e*Saint John of God Liffey Services, Dublin, Ireland*

Abstract. Digital technology is now pervasive, however, not all groups have uniformly benefitted from technological changes and some groups have been left behind or digitally excluded. Comprehensive data from the 2017 Current Population Survey shows that older people and persons with disabilities still lag behind in computer and internet access. Furthermore unique ethical, privacy and safety implications exist for the use of technology for older persons and people with disabilities and careful reflection is required to incorporate these aspects, which are not always part of a traditional software lifecycle. In this paper we present the Inclusion4EU project that aims to co-design a new framework, guidelines and checklists for inclusive software design and development with end-users from excluded categories, academics with expertise in human-computer interaction and industry practitioners from software engineering. The framework can be used by educators in Computer Science and related disciplines to teach software design and development methodologies in a more inclusive way that considers the diversity of end-users for software products and services.

Keywords. Inclusive Software Design and Development, Diversity of End Users, Co-Design, Software Engineering, Older Adults, Persons with Disabilities

1. Introduction

Inclusive or accessible design is a process where the needs of specific groups of people such as older adults or persons with disabilities are specifically considered in technology products and services. The practice is gaining recognition in tertiary and third-level Computer Science curricula. However, we know from experience that scant university courses involve students working with persons from diverse backgrounds including older adults or those with disabilities in order to design and development software that supports their needs. Many Computer Science lecturers do not have the requisite training to facilitate collaborative design and development sessions involving stakeholders. Computer Science lecturers require upskilling in the multi-disciplinary area of co-design – the act of creating with stakeholders to ensure the results meet their needs. We argue that inclusive software design is a crucial component of Computer Science students' education. From an industry standpoint, the degree of stakeholder involvement in the software design and development process is largely based on the tools, time, and resources available on any given project. Software design and development teams have to weigh the benefits of co-design, working collaboratively with diverse sets of stakeholders and finding ways to communicate meaningfully against the costs of its administration. However, this lack of meaningful stakeholder involvement can result digital exclusion - that is where a section of the population have continuing unequal access and capacity to use technology which in turn can lead to significant ethical, legal and financial deficiencies.

An estimated 135 million people in Europe live with a disability [1]. With population ageing and the rising prevalence of chronic health conditions due to non-communicable diseases and injuries, this number is set to increase. Comprehensive data from the 2017 Current Population Survey shows that older people and persons with disabilities still lag behind in computer and internet access [2]. The European Union has recognized the importance of inclusion and accessibility in the digital domain and is in the process of implementing a digital strategy via policies such as the Digital Inclusion [3] and a number of pieces of legislation. The EU vision for digital transformation (via the European Declaration on Digital Rights and Principles [4]), encompasses digital sovereignty, inclusion, equality, sustainability, improving quality of life, and respect of people' rights and aspirations. Digital inclusion is also underpinned by the EU Web Accessibility Directive of 2016 [5] and accessibility has been included as a transversal competence in the EU e-Competence Framework for ICT Professionals [6]. Tertiary and third-level education and industry need to respond to embrace active inclusion in their curricula and teaching materials and development practices.

In addition to legislative aspects, the social timing of this work is important. Society is increasingly technology-driven with new developments precipitated by Covid-19. Technologies such as AI are becoming mainstream and 2023 has seen significant advances in Generative AI technologies. We live in the shadow of technology scandals that have not properly considered the consequences and impacts of technology on end users. Technology practitioners including Computer Science educators need to consider new practices for truly inclusive software design that ensure that no end users are left behind, further marginalized or negatively impacted.

To address digital exclusion in software design and development, a group of European Universities have developed a consortium, Inclusion4EU, funded under the Erasmus+ Strategic Partnership programme. The aim of the Inclusion4EU project [7], is co-create a framework, guidelines and checklists for inclusive software design and

development with co-design teams formed of academics with expertise in inclusive design, software designers and developers, and persons from excluded categories including older adults and persons with physical and cognitive disabilities. The project is focused on the exploration of ways in which inclusive human-centered design can be incorporated into the software development process and looking at ways to develop teaching materials to enable students and subsequent industry graduates and practitioners to gain a wider appreciation of the software design process through authentic partnerships with end-users. Our planned project activities include:

1. Reports on good and bad practices in software design and development, researched and created by pan-European partners;
2. A survey of European institutions about their current practices and future needs for teaching inclusive software design;
3. Co-design sessions including participants from across Europe to create a shared European understanding around the needs, capabilities and preferences of older adults and people with disabilities for inclusive technology;
4. The publication of a co-created framework for inclusive software design and development which will include design patterns, guidelines and checklists to maximize technology inclusion;
5. The creation of a European Community of Practice on inclusive software design and development align that will strongly with European Digital Inclusion initiatives.

This paper focuses on project activities 3 (co-design sessions), 4 (a co-created framework for inclusive software design), and 5 (a European Community of Practice). We will describe our planned approach to co-create a framework, guidelines and checklists for inclusive software design and development with co-design teams formed of academics, software designers and developers, and persons from digitally excluded categories and the development of a sustainable Community of Practice in inclusive design to ensure widespread dissemination of findings and best practice.

2. Background

2.1 Digital Exclusion

Broadly defined, digital exclusion is where a section of the population have continuing unequal access and capacity to use technologies that are essential to fully participate in society [8]. Digital technology is now very much at the center of how public, economic and social life functions. It has transformed how we work, communicate, consume, learn, entertain and access information and public services. However inclusive digital design is less common than it should be for online spaces and technologies and as such the spread of access and use is uneven and many people remain digitally excluded [9]. Those who are excluded can be limited or unable to participate fully in society. Some groups are particularly affected, with a concentration of certain demographics within the digitally excluded. Studies show that overall, non-users are increasingly older, less educated, more likely to be unemployed, disabled, and socially isolated [10]. Older people have consistently made up the largest proportion of internet non-users, and patterns of internet use by age is replicated when looking at digital skills [11, 12]. Many older adults face problems in performing basic tasks such as accessing

government services or banking. Another challenge is social exclusion faced by elderly because they cannot connect with peers through networks due to lack of digital skills. Roulstone describes the Internet as 'inherently unfriendly' to people with many kinds of disabilities, with barriers to access and usage varying by the type and extent of disability [13]. Ofcom data from the UK in 2022 revealed that 56% of adult internet non-users were disabled. The same report showed that 47.7% of the non-user population responders have a long-standing illness, disability or infirmity [14].

Being digitally excluded and a lack of digital access can have a huge negative impact on a person's life, leading to poorer health outcomes, a lower life expectancy, increased loneliness and social isolation, less access to jobs and education further widening the social inequality gap. It can also mean paying more for essentials, financial exclusion, and an increased risk of experiencing poverty. People who are digitally excluded also lack a voice and visibility in the modern world, as government services and democracy increasingly move online.

2.2 Co-Design

Co-design is a methodology where the end user actively and authentically participates in the process as an active co-designer [15]. The collaboration between the researcher and the co-designer goes further than the practice where the user is invited to participate in the processes of gathering and evaluating requirements, it is through this collaboration that they give value to the product or service by creating more meaningful experiences for the users [16]. The wide recognition of the role of co-design in improving the design of products has resulted in several studies investigating collaboration between researchers, stakeholders, and co-designers, primarily in medical and technology use. Participatory design approaches such as co-design are particularly important for the creation of inclusive technologies as a way for developers to understand the lived experiences of those that they are designing for.

A vital aspect of the co-design process is to coach the end-users to be authentic partners in the design process, and to ensure that they are not merely supplying information but are instead equal partners who are making key decisions on the design process. This is made possible by developing trust between all parties, when people undertake honest conversations and actively listen to each other, trust will grow over time, where all parties feel they are being heard, and are all empowered by their relationships, the outcomes will be more authentic and more sustainable.

3. Methods

The objectives of the co-design activities in the Inclusion4EU project are to: create a shared understanding of the existing software design and development process and propose how the process can be more inclusive; explore end users' experiences in best practices in inclusive technology; explore end users' current challenges and pain points with regard to existing technology; gain a deep understanding of the requirements and preferences of end users with regards to technology; co-create a framework, guidelines and checklists for inclusive software design and development; train academics and industry professionals with practical experience and knowledge of designing and running co-design sessions for inclusive design. In order to achieve these aims we will run co-

design sessions where participants will include end-users from marginalized groups, academics and software engineers.

3.1 Requirements Gathering

Semi-structured interviews are currently being conducted involving three groups of stakeholders – end users (older adults, persons with physical disabilities, and persons with intellectual disabilities), academics with experience in inclusive design and software industry practitioners. The interviews with stakeholders are examining the role technology plays in their lives, the types of technologies that users interact with, as well as articulating their needs and preferences for possible technological solutions to support their independent living, examples of technologies that they consider to be well designed, and challenges and barriers that they face when using technologies.

Interviews with academics are aimed at understanding methods for inclusive designing including the co-design process and the role it can play in moving beyond participation by focusing more on co-production which is a key aim of our research.

Interviews with industry practitioners are focused on end-to-end software lifecycles in industry and whether and how inclusion is facilitated as part of those processes. For example, we are asking software designers and developers about inclusion criteria as part of a user analysis phase, whether and how they follow accessibility guidelines (e.g. WCAG [17]), as part of information architecture analysis in the planning phase, and if and how diverse end users are part of the software evaluation phase.

Following thematic analysis of the interview data, we aim to design and conduct a series of co-design workshops to interactively explore the themes arising from the interviews.

3.2 Co-Design

The next phase of our research is to run a series of co-design sessions where we will bring together the three groups of stakeholders to collect rich data and shared insights into experiences of all stakeholders, create topics for discussion and an open forum for knowledge exchange where all participants are considered equal experts. We believe it is important not only to gain insights from the end users but also for them to work with academics and industry professionals to co-create the final framework, guidelines and checklists for inclusive design so that their voices are firmly embedded in the resulting output.

Throughout the co-design sessions, methodologies such as personas, scenarios and storyboards [18], will be used to explain technology and design concepts in lay terms to participants. The same participants will be involved in the co-design workshops as took part in the interviews phase.

From organizing and running the co-design sessions, we will collect a knowledge base of practical findings about running sessions involving diverse end user. Using this knowledge base we can create useful and open resources for academics. These will include lessons, activities, assessments and instructor guidance for academics with practical advice on how to incorporate co-design activities into their teaching. A key goal of this content will be to enhance the learners' skills in terms of working with end-users as partners, which includes a number of "soft skills" such as communication, teamwork, patience, and respect.

3.3 A co-created framework for inclusive software design and development

Our co-created framework will compose a set of accessible, open and easy-to-use educational resources on inclusive software design for Computer Science lecturers that they can use to deliver content to students to reflect and learn about inclusion and accessibility. Equally the resources can be used by graduated and industry practitioners as part of their design and development processes. Specifically, we will produce at least six case studies on exclusionary design or non-inclusive design, at least six case studies on good examples of inclusive and accessible design, at a set of open resources for specific use in the software design lifecycle. These will include design patterns and frameworks for inclusion, compliance checklists, and templates that can be used to incorporate inclusion from scratch within the software design development process.

3.4 A European Community of Practice in inclusive software design and development

We will create a virtual space for networking for Computer Science lecturers, industry professionals, inclusive design experts, end users and others with an interest on inclusivity. The members will be able to upload resources on the platform, exchange ideas, thoughts and opinions and ask for advice from the other members. Through the Community of Practice we aim to extend and maintain the project in the future by networking with new potential partners and collaborators.

4. Conclusions

Digital exclusion should be understood in relation to the wider issue of social exclusion, as many groups who are side-lined socially have the same experience digitally. The aim of the Inclusion4EU project is to tackle digital exclusion from the point of the software design and development process by co-creating a framework for inclusive software design and development with co-design teams formed of academics with expertise in inclusive design, software designers and developers, and persons from excluded categories including older adults and persons with physical and cognitive disabilities.

The impacts of a truly inclusive software design and development approach are many-fold: for older persons and persons with disabilities, their needs are considered, they are given a voice and empowered as part of an inclusive software design and development process, and gain design skills as part of the co-creation process. For Computer Science lecturers, they gain new experience in participatory processes and develop new skills in designing and delivering new curricula. For Computer Science students, they benefit from innovative pedagogical approaches that allow them to work with stakeholders, develop technology while building empathy with end users and gaining an insight into lived experiences. For resulting industry professionals, they benefit from best practices in inclusive software design and the resulting software they build is usable by as many groups of end users as possible. The Inclusion4EU project aims to co-create such a framework for inclusive software design and development and to develop open resources that can help students and subsequent industry graduates to

reduce blind spots in order to produce more useable and accessible technology products and services.

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