

User-centred Design of an Educational Cybersafety Application for Users with Intellectual Disability

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Declaration Statement

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CYBERSAFE ONLINE APPLICATION PROTOTYPE

The final *CyberSafe* prototype application is hosted online at <https://weathered-cell-5036.animaapp.io/homepage>, and is a standalone instructional application, covering six modules which are interactive.

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ABBREVIATIONS

ADHD	Attention Deficit Hyperactivity Disorder
CR	Camtasia recordings
DBR	Design Based Research
DSM	Diagnostic and Statistical Manual of Mental Disorders
GATE	Global Cooperation on Assistive Technology
HCI	Human Computer Interaction
IADT	Institute of Art Design and technology
ID	Intellectual Disability
PAR	Participatory Action Research
PWID	People with Intellectual Disability
RO	Researcher observation
SATLE	Strategic Alignment of Teaching and Learning Enhancement
SJOG	St John of God
SJT	Social Justice Theory
SST	Social Shaping of Technology
SW	Support worker
UCD	User Centred design
WHO	World Health Organization

User-centred Design of an Educational Cybersafety Application for Users with Intellectual Disability

Marian McDonnell

Abstract

The purpose of this Ph.D. was to research and design an online educational application about cybersafety for young people with intellectual disability (PwID), employing a user-centred design (UCD) methodology. PwID are twice as likely to be victims of cyber victimisation as their peers. The context for this Ph.D. study is the increasing demand from stakeholders for interactive educational materials about cybersafety for vulnerable PwID, with a wider inclusive agenda to include PwID in their design. The focus of this study was primarily on PwID engagement in the UCD process, as opposed to investigating the effectiveness of the learning from an instructional perspective. The digital divide theoretical framework as it applies to PwID and the importance of digital literacy including cybersafety for this vulnerable user group are discussed as well as the lack of suitably designed educational resources. User-centred, participatory and codesign approaches are explored as are recommendations for interface design for PwID. The literature review culminates with a discussion of the dimensions of user experience i.e., usability, engagement and aesthetics in relation to PwID. The thesis then describes three phases of UCD research, during which four qualitative datasets were collected and analysed using thematic analysis. Three key contributions resulted from this study: firstly, a wide range of insights related to cybersafety for PwID, such as their vulnerability to celebrity catfishing and how risk exposure can result in positive personal growth. Secondly, a usable educational prototype application called *CyberSafe* was co-designed and finally, a toolkit of best practice for UCD for PwID under four headings (Research, Methods, Tools and Content Design) recommended the use of step-by-step videos, interactive video and interactive exercises to enhance accessibility, engagement and usability for PwID. The final *CyberSafe* prototype is a hybrid web application, which can run on mobile, tablet or desktop as an educational tool.

1 INTRODUCTION

1.1 Introduction

This thesis will present the research, design and usability evaluation of an instructional application to promote cybersafety for young adults with intellectual disability (ID). The final *CyberSafe* prototype application is hosted online at <https://weathered-cell-5036.animaapp.io/homepage>, and is a standalone instructional application, covering six modules which are interactive. Byron (2008) states that vulnerable people offline are also vulnerable online. Young adults with ID are particularly vulnerable. This PhD research study aims to address the limited educational materials available to offer either them or their carers an educational resource as they transition into adulthood and face a new and changing world. This introductory chapter details the background to the research idea and describes the context of the research problem. It identifies the gap that exists in the current research and outlines the contributions of this research study. It outlines the research aims, objectives and questions, and their significance and limitations. The chapter concludes with a summary description of each of the remaining thesis chapters.

Intellectual disability (ID) is defined as a neurodevelopmental disorder involving impaired adaptive and intellectual functioning which is categorised by deficits in social, practical, and conceptual aptitudes (APA, 2024). For example, individuals with ID may experience deficits in areas of abstract thinking, learning, judgment, and problem-solving. These adults have a right to be included and society has a responsibility to ensure that future development takes an inclusive approach to designing for diversity (Murphy *et al.*, 2022). Adults with ID have a specific set of user accessibility needs and are increasingly at risk of lagging behind in terms of online access and participation (Alfredsson Ågren, Kjellberg and Hemmingsson, 2020).

When included, people with ID (PwID) are at increased risk of cyber victimisation (Normand and Sallafranque-St-Louis, 2016). The digital world is a daily component of modern life and can present users with both benefits and risks (Chadwick, Chapman and Caton, 2019). There is a lack of research regarding cybersafety and online danger in

connection to persons with intellectual disability (PwID) and a limitation of previous research in this field, is that it focused purely on those with mild cognitive impairment, who seemed able to independently manage online risk (Chadwick, 2022). Research is needed to understand how digital risk is experienced by individuals who face heightened vulnerability to online criminal victimisation and perpetration. This appears to be a significant omission, since cybervictimisation has serious detrimental effects. This current *CyberSafe* research study aimed to research the experiences more vulnerable persons with intellectual disability face online and to address the gap in limited educational material available for them or their carers. More thought needs to be given to the assistance options available for managing online risk (Seale and Chadwick, 2017).

Delgado *et al.* (2019) recommended more research should discover ways to teach safe internet skills to this user group. The need for educational programmes for people with intellectual disability to prevent cyber bullying, cybercrime and cyber victimisation has been recommended before (Lussier-Desrochers *et al.*, 2017). This current research study aimed to design a digital educational implementation to meet certain needs. This research study also considers the question of whether online instructional technology can be designed to be sufficiently inclusive in meeting the needs of young adults with intellectual disability (ID). To achieve this goal, this research study adopts a user-centred design methodology. User centered design (UCD) describes a design process that involves the potential user at all stages: requirements, prototyping, testing and evaluation (Sharp, Rogers and Preece, 2019). UCD sees users and their goals as the main directing force behind product development and is achieved by involving users in the design and evaluation process. Although UCD involving People with ID (PwID) is not common practice, the Web Accessibility Initiative (Dekelder *et al.*, 2015) recommends it.

This study led to the design of a digital prototype, called *CyberSafe*, with the aim of educating and empowering young adults with ID to participate online in a safe way. *CyberSafe* is a hybrid web application, which can run on mobile, tablet or desktop as an educational tool. It is hosted online at <https://weathered-cell-5036.animaapp.io/homepage>. The *CyberSafe* educational prototype was co-designed with the co-operation of 12 PwID with mild to moderate intellectual disability and the support of care workers and instructors with the aim of getting an insight into the level of difficulty they experienced using instructional interfaces.

1.2 Background

The recognition that those with intellectual disability (ID) have rights and needs just like others is a relatively novel concept. However, even with this recognition, the world can still appear inaccessible to a large proportion of the ID population. This is true of technological advances for the ID population as well. Adolescents with ID have significantly less access to internet-based devices than typically developing adolescents (Alfredsson Ågren, Kjellberg and Hemmingsson, 2020). This group is frequently ignored and excluded from technology. This is because of their intellectual ability and sensorimotor needs (Persson *et al.*, 2015). The lack of equality in access to the internet for people with ID has been researched (Caton and Chapman 2016; Chadwick, Wesson and Fullwood, 2013). People with intellectual disabilities used digital technology to a lesser extent compared to peers without an intellectual disability (Kaplan and Haenlein, 2010).

More recent research has shown that not everyone can easily access digital content, particularly people with intellectual disabilities (Chadwick *et al.*, 2022). Studies conducted during and following the COVID 19 pandemic have suggested that a growing number of people with intellectual disabilities are using devices and technology to access benefits (Courtenay and Perera, 2020). Murphy *et al* (2024) reported that while PwID could access technological devices, they did not have their own autonomous devices until the pandemic. The access to technological devices was obtained mainly through family members and community days or educational support services. The COVID 19 pandemic acted as a catalyst to improve access to the internet and social media sites, which offered people alternative ways to interact with peers and build relationships. It was during the pandemic that many PwID received their first devices. Within this context of relationship building, digital inclusion was seen as a key element to social inclusion (Bayor *et al.*, 2021). These researchers found in their study, that PwID had a personal stake in taking part in online activities for social inclusion, with 72% of their participants reporting that they were keen all the way through the study to take part in online activities. These results suggested that internet usage holds value for people with intellectual disability to engage with their social connections.

There are benefits and obstacles when it comes to keeping these vulnerable adults safe online (Chalghoumi, 2019). Chadwick, Wesson and Fullwood (2013) described the

benefits of internet participation. The benefits include friendship possibilities and increased self-esteem through social media identity (Caton and Chapman, 2016). Borgström, Daneback and Molin (2019) reported that obstacles and concerns include reading and communication difficulties, cybersafety issues, access to the internet and accessible devices and interfaces. Even though there are multiple ways in which digital applications could improve the lives of people with cognitive impairments, much of existing technology remains cognitively inaccessible in its design (Moreno, Petrie and Martínez *et al.*, 2024). There is a lack of suitable accessible and appropriate digital learning resources available for their needs. Even though, there is a proliferation of apps available, and this number is growing at a rapid rate, it appears that there are few applications that are accessible to PwID. Young people with ID have more difficulty communicating via text messages and searching for information. This is because of a "Digital lag", a term used to describe someone who is slow to adapt to digital interfaces or who is falling behind in the digital era (Alfredsson Ågren, Kjellberg and Hemmingsson, 2020). When accessibility is considered in design and development, the emphasis tends to be on users with a visual or listening impairment (Dekelver *et al.*, 2015).

1.3 ID and Internet safety

Internet Safety is a topical subject for all age groups and sectors from children to adolescents to adults and society in general. Furthermore, research conducted for this study highlights there is a substantial gap in information or guidance relating to adults with ID and online safety. Knowledge about PwID and the internet is limited, especially about young people and social media. A UN survey of 20 countries in 2019 reported every third young person has been a victim of cyberbullying. Furthermore, PwID are at a much greater risk of cyberbullying than other groups (Jenaro *et al.*, 2018). Alfredsson Ågren, Kjellberg and Hemmingsson (2020) reported that PwID are twice as likely to be cyberbullied compared to neurotypicals. Several authors have suggested ways of tackling these issues by way of educational programmes (Jenaro *et al.*, 2018), developing effective coping strategies (Wright, 2017), promotion of cybersafety to help to provide more opportunities for PwID to be proactive in choosing their path in life (Delgado *et al.*, 2019). Additionally, Murphy *et al.* (2024) demonstrated the need for accessible training on safe and effective internet usage.

Both mobile and desktop devices are successful towards independence for people with ID (Stephenson and Limbrick, 2015). *CyberSafe's* user-centred design methodology determined which of these two platforms (desktop or mobile) was best suited to the users' needs. These findings emphasise the gap and highlight the need for further studies on cybersafety for this unique user group, as well as the challenge of designing accessible and appropriate educational interventions. Recommendations for future research in these papers indicated that there are opportunities to use digital solutions to educate young adults with ID about cybersafety.

1.4 Research aims objectives and questions

Set against this backdrop the aims of this study were:

1. To conduct research to understand the challenges in staying safe online for this user group through interviews with stakeholders, and empathy and co-design workshops with the PwID.
2. To design an accessible cybersafety instructional application for PwID.
3. To test and research the usability of this instructional application.
4. To explore and adapt a methodological approach to the practice of user-centred design for this user group.
5. To add to the body of knowledge about and to address the deficit in the approach to UCD for PwID.

The study objectives are:

- To identify issues around cybersafety for this user group.
- To design the educational application in a way that is usable and engaging for people with ID.
- To add to the body of knowledge in user-centred design recommendations for PwID.
- To share insights found on codesigning interfaces for PwID interactions.

1.4.1 Research Questions and outcomes

The research questions that this study addressed were:

- What themes do stakeholders identify around cybersafety for this user group?
- What themes around cybersafety do young adults with ID report?
- What aspects of a participatory design/co-design workshop work for this user group?
- What usability, satisfaction and engagement issues did this user group report when using the *CyberSafe* prototype, which was developed using a UCD methodology?
- What is an effective process of applying a UCD methodology to the design of an educational cybersafety application for young adults with ID?

1.4.2 Theoretical Framework

This *CyberSafe* study draws on an integrated theoretical framework combining Social Shaping of Technology (SST), Digital Divide and Social Justice theories to examine digital technology design for PwID. This thesis positioning is that SST challenges technological determinism by emphasising that digital technologies are socially constructed artifacts shaped by institutional priorities, cultural assumptions, and dominant norms of cognitive ability (MacKenzie & Wajcman, 1999). From this perspective, instructional applications are understood as sociotechnical systems that embed particular values and expectations about who is able to use and engage with them. Design choices in instructional applications, such as interaction modalities, can enable or constrain participation for PwID. These design decisions shape access, agency, and recognition within digital environments, aligning closely with the digital divide's concern for meaningful participation rather than mere physical or digital access.

Social Justice Theory provides the normative lens for evaluating these sociotechnical arrangements. While Rawls's (1971) framework emphasises fairness and equal opportunity and provides a foundational basis for equity in access to digital resources, Social Justice theory extends beyond access-based models. Bell's (1990) theory of Social Justice aligns closely with this thesis's emphasis on user participation and voice. Together, these perspectives foreground how digital technologies, when codesigned through participatory and justice-oriented approaches, can promote equity, agency, and belonging.

1.4.3 Methodology

The DSM-5-TR classifies four degrees of ID: mild, moderate, severe and profound. In this research, cognitive abilities vary widely even amongst people with the same disability (APA, 2022). Participants at different levels were attended to by creating accessible consent and workshop materials. There were two different versions of information and consent forms designed for this study. These differentiation challenges highlight the lack of conceptual and theoretical frameworks for this kind of research as well as the ongoing ethical and practical challenges of recruiting participants and carers to take part in the research.

This research study adopted a user-centred design (UCD) methodology. The study was conducted in three phases. The three-phase user-centred design process was effective in producing an engaging and usable educational cybersafety application for young adults with intellectual disability, during the timeline 2021 to 2023. During the course of this research study, eight user-centred design workshops were conducted. Early workshops involved discussion of 12 participants' views on their experience online and participation in codesign activities. Later workshops researched their ongoing response to the instructional application, being iteratively co-designed to meet their educational needs, using a user-centred design methodology. As part of the research, an accessible system usability scale (SUS) was adapted so that young adults with intellectual disabilities could provide data about their digital accessibility challenges. This was important, as the voices of young people with intellectual disabilities are seldom heard in research (Chadwick, Quinn and Fullwood, 2017; McDonald, Kidney and Patka, 2013). The three phases of the research were organised as follows:

- Phase one explored cybersafety issues related to user needs. A series of interviews with four subject matter experts and a survey with 14 service workers, conducted in spring 2021, aimed to identify difficulties and challenges young adults with intellectual disability encounter in the area of cybersafety. Following this, empathy workshops were held with 12 PwID in spring 2022 to explore their experience online.
- Phase two conducted in May/June 2022 and Nov/Dec 2022 involved co-designing solutions based on data collected in the first phase and iteratively designing an appropriate application through two rounds of codesign and lab testing with 12 participants with mild to moderate ID.
- Phase three, informed by data from the previous two rounds of iteration and codesign activities, resulted in the final prototyped solution being evaluated for usability and engagement by 11 new users with ID in spring 2023. The data gathered during this usability evaluation provided insight into the performance of the application and will aid in any subsequent design iteration.

Within the context of this Ph.D. research thesis, this study produced the following outcomes:

- A thick description of the themes emerging from the stakeholders and users themselves concerning the issues they face around cybersafety.
- A co-created educational artefact called *CyberSafe*.
- Usability, engagement and satisfaction data reported by users when using the application.
- Guidelines for appropriate user-centred design of similar applications.

The contribution to knowledge emerging from the research can be classified as follows: firstly, it provides a wide range of insights related to cybersafety for PwID, such as their vulnerability to celebrity catfishing and how risk exposure can result in positive personal growth. Topics like respect, safety, privacy settings on apps, requests from unsolicited friends and cyberbullying did emerge. Secondly, it has created a usable educational prototype application called *CyberSafe* that was co-designed with PwID. The key

topics included in the final CyberSafe educational application evolved from the user and stakeholder research via interviews and workshops. Finally, this CyberSafe study contributes to the literature an archetype of “successful” user-centred design for PwID, in the form of the production of a comprehensive toolkit. This toolkit of best practice for UCD for PwID is presented under four headings (Research, Methods, Tools and Content Design). Under Content Design, the toolkit recommends the use of step-by-step videos, interactive video and interactive exercises to enhance accessibility, engagement and usability for PwID. The production of a tangible, practical toolkit, that places the co-designers’ opinions at the heart of the user centred design process, aims to ensure subsequent follow up and impact.

Like all research, *CyberSafe* has its limitations. It is not possible to generalise the findings to the population because of the small number of participants. Although a significant amount of effort was made to recruit a broad range of participants with ID, the study sample size remained relatively small. Furthermore, the 23 participants were heterogeneous in their intellectual ability with a mixture of mild and moderate ID. One notable weakness in research previously carried out with these participants is the grouping together of people with ID. ID ranges are extremely large, which in turn, means user needs vary in a copious number of ways. The DSM-V (Diagnostic and Statistical Manual of Mental Disorders), defines a person with ID as one who is “significantly limited in at least two of the following areas: self-care, communication, home living, social/interpersonal skills, self-direction, use of community resources, functional academic skills, work, leisure, health, and safety (Dawe, 2006).

1.5 Overview of Chapters

This thesis has seven further chapters, as follows:

Chapter 2 presents the literature explaining intellectual disability in detail. This chapter then explains the digital divide theoretical framework and the importance of digital literacy for PwID. The more recent term of “digital lag” (Alfredsson Ågren, Kjellberg and Hemmingsson, 2020) is discussed as it applies to adults with intellectual disability. Assistive technology as a gateway for people with ID is explored in the historical context of research

developments over the last 15 years. The literature review culminates with reviewing general design principles for interface design for this user group.

Chapter 3 describes the research design of the study, and the research tools available are discussed. There is a rationale provided as to why the chosen set of research tools are the best fit for this research study and its research questions. Ethical considerations, confidentiality and anonymity are discussed. Methodological considerations, the context setting and theoretical discussion are provided.

In Chapter 4, the development of the research tools used at each stage of the study are described. The participant information, materials and procedures are outlined for each of the four data collection points in the study's lifecycle. Data technicalities, consistency and validation, the coding process and data analysis are included in this chapter.

Chapter 5 documents how the researcher, through each stage of *Cybersafe's* iteration, made interface design decisions based on stakeholder and user data. The results from this user-centred design process informed the design of the prototype to be iteratively developed. The development and use of *CyberSafe's* personas and empathy diagrams are included in this chapter.

Chapters 6 presents and interprets results, identifying metathemes emerging from research carried out with the target users and their stakeholders. It reports on the challenges associated with cybersafety in terms of stakeholder and PwID perspectives. It also reports the results and themes that emerged from two iterative co-design and prototyping stages. It concludes with results from the final *CyberSafe* usability research stage, through Camtasia screen recordings, self-reported feedback from PwID and observation studies, conducted by the researcher, on usability and engagement patterns while engaging with the *CyberSafe* application.

In chapter 7, results are discussed and opportunities for further research explored. Insights on a contextual and customised approach to co-design with young people with ID are presented. Chapter 7 concludes by offering a four-quadrant model of workable recommendations from the findings of this research that can be used to guide design teams through the process of user-centred design for this user group. This four-quadrant model is entitled *Cybersafe's Toolkit for User centered design with PwID*. The toolkit describes

recommended best practice UCD for PwID under 4 different headings: Research, Methods, Tools, Content Design.

Chapter 8 is the conclusion section which discusses the outcomes of this research study, its findings and implications as a whole. It discusses theoretical and practical implications, its strengths and limitations and opportunities for future research.

2 LITERATURE REVIEW

2.1 Introduction

This literature review chapter will start by defining and discussing intellectual disability (ID). This chapter will then discuss the Digital Divide framework, in the context of how it applies to Persons with Intellectual Disability (PwID). The digital divide theoretical framework and the more recent term of “digital lag” (Alfredsson Ågren, Kjellberg and Hemmingsson, 2020) as they apply to adults with intellectual disability are discussed in depth. This “lag”, experienced by adult users with ID, is due to costs, barriers and obstacles faced by users, carers and instructors, and the ongoing challenges of providing a cognitively accessible internet. Digital literacy is then discussed as it is an important enabler for PwID to bridge the digital divide. It can support their skill development and enhance their communication and social interaction abilities. However, they face specific challenges when it comes to accessing and using digital technologies. They require appropriate support and training to ensure they have the necessary skills and knowledge to use technology effectively and safely as responsible digital citizens. The topic of cybersafety and cyberbullying will then be explored in detail for this user group as it is the one of the main topics to be included in the instructional *CyberSafe* application. The Organisation for Economic Co-operation and Development (OECD), reported in 2022 that young people with intellectual disability (PwID) were twice as likely to be victims of cyber victimisation as their peers. As digital literacy increases and more PwID use social media, the OECD report argued that without support, the frequency of cyberbullying and cyber victimisation will drastically increase for this cohort. One of the most cited challenges contributing to the technology digital lag between society in general and PwID relates to the inaccessibility of digital interfaces due to their design (Bayer *et al.*, 2021, p.6.).

As this is a human computer interaction (HCI) research study, which Preece, Sharp and Rogers, 2015, p.10 define as the ‘design, evaluation and implementation of interactive computing systems for human use’ and the study of phenomena surrounding them, the

topic of HCI is introduced. Use of assistive technologies for the user group and designing for their cognitive challenges are discussed.

2.2 Intellectual Disability

The terms used for 'intellectual disability' vary depending on the context and nation, for example, 'developmental disability' is the term used in Canada and 'learning disability' in the United Kingdom' (Borgström, Daneback and Molin, 2019, p.131). Therefore, in this literature review, the terms 'intellectual disability' and 'intellectual disabilities' are utilised interchangeably, except in the case when referencing studies which use the term 'learning disabilities'. Intellectual disability (ID), as defined by the American Psychiatric Association, (2024) is categorised as a neurodevelopmental disorder resulting in impairments in intellectual and adaptive functioning. According to the Diagnostics and Statistical Manual of Mental Disorders (DSM), released in 2022, ID is listed under the Neurodevelopmental Disorders. The reason for this is that the disorder manifests in early childhood development. DSM is the authoritative diagnostic manual published by the American Psychiatric Association (APA) that defines mental disorders and provides standardised diagnostic criteria.

The three main areas affected include the conceptual, social and practical domains. Four grades of ID have been identified; mild, moderate, severe and profound. (American Psychiatric Association, 2024). Average IQ is 100. Mild IQ is 50-69. Moderate IQ range is 35 to 50. Severe is 20-35. Profound is below 20. Intellectual disability affects about one percent of the population. Males are more likely than females to be diagnosed with intellectual disability ([Psychiatry.org](https://www.psychiatry.org), 2021). This can be explained by the effects on learning of hormonal sex differences, maturation rate differences, together with differences in frequency of perinatal brain injury between males and females (Nass, 1993). Complications of pregnancy and the new born are more common in males. The male and female foetus and infant differ in their hormonal makeup. Males only are exposed to male hormones— androgens. The effects of male hormones on the nervous system may explain some learning disabilities specific to males.

In Ireland, in 2016 as recorded by the Census (CSO, 2021), 66,611 persons were reported as having an intellectual disability. This represented 1.4 per cent of the population. Figure 1 shows that there were more than double the number of males with ID than females for the same ages. Neurodevelopmental disorders such as autism and intellectual disability/developmental delay (ID/DD) are associated with a sex bias, with the diagnosis skewing towards boys compared to girls (Polyak *et al.*, 2015).

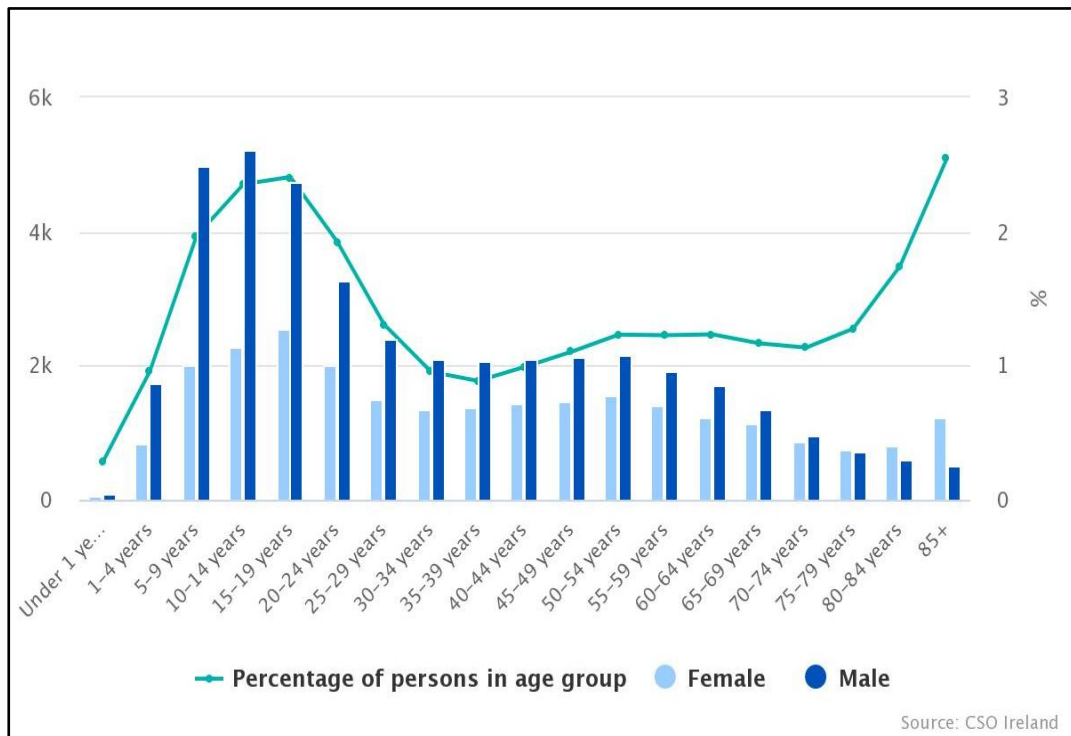


Figure 1 Irish males and females with an intellectual disability (Source: CSO, 2016)

Among this group, the most common comorbid disability was difficulty with learning and remembering with 47,390 (71.1%) PwID, followed by psychological issues which affected 24,024 persons (CSO, 2021). See Figure 2.

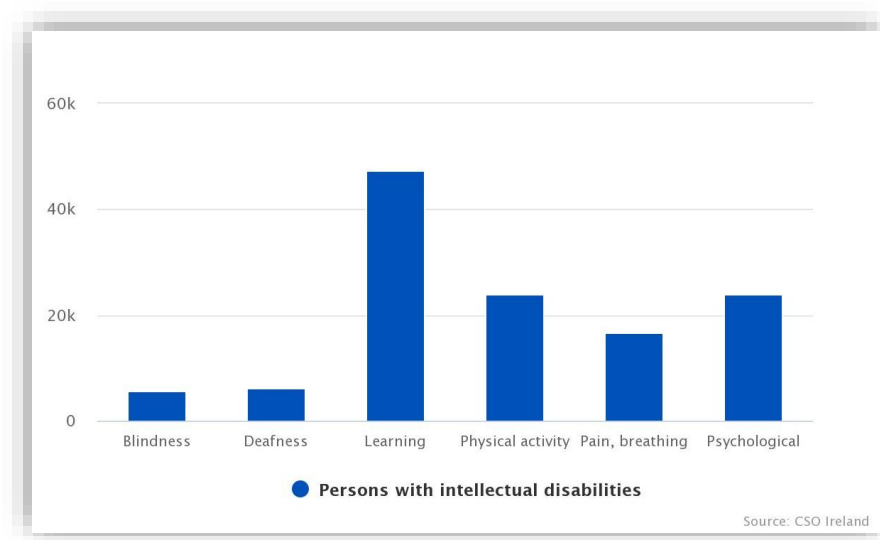


Figure 2 Other disabilities faced by Irish people with ID (Source: CSO, 2016)

The 2022 census (CSO, 2023), shows that the total number of people who experienced an intellectual disability was 109,288 people. This is over one third of an increase since the 2016 census. Some of the reasons for this increase in numbers are general population growth and an increase in migration into Ireland in that same period (CSO, 2023).

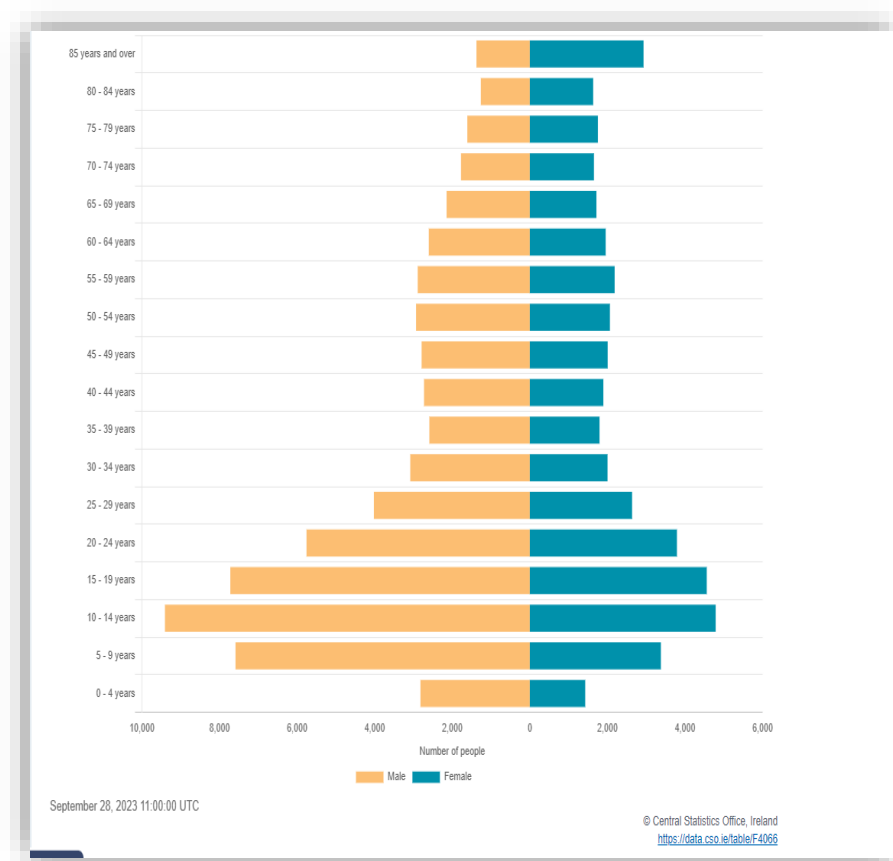


Figure 3 Irish males and females by age range with an intellectual disability (Source: CSO, 2022)

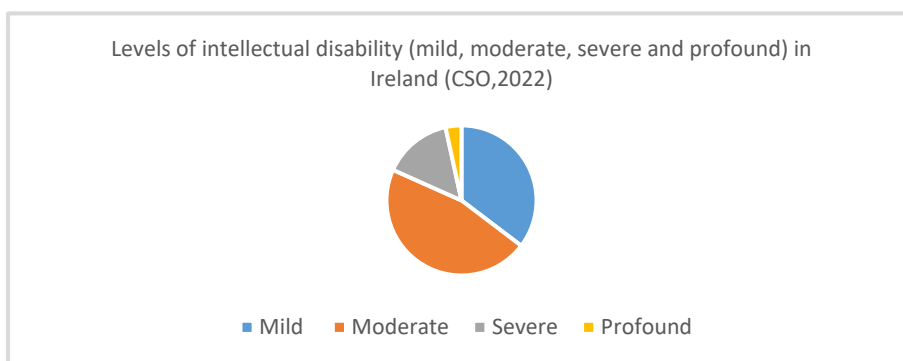


Figure 4 Pie chart displaying the different levels of intellectual disability (mild, moderate, severe and profound) in Ireland based on the data from CSO (2022)

Intellectual Disability is further divided into syndromic or non-syndromic. Syndromic includes disorders such as Down syndrome (DS), Prader-Willi syndrome and Fragile X. Non-syndromic disorders include autism, epilepsy, mental health issues and vision disorders (Evenhuis *et al.*, 2001). Causes of ID have been found to be environmental or genetic. DS and Fragile X have genetic causes (Simpson *et al.*, 2016). People with ID usually have both physical and mental impairments. Families and the wider community of people with ID are

also affected by the condition as people with ID depend on others to carry out activities associated with daily life such as personal care, school, employment, recreation, communication and socialising (Maulik and Harbour, 2010). It is estimated that 1% of people worldwide are affected by ID (Maulik *et al.*, 2011). In recent years, people with ID are living longer (O'Dwyer *et al.*, 2016) with Simpson *et al.* (2016) forecasting that in 2020 the number of people with ID over the age of 65 would be double what it was in the 1990's. ID presents itself in different forms. Some of the main issues for ID are outlined in Table 1.

Table 1 Summary of the main issues for these types of intellectual disabilities

Disability type	Main Issues	Impairments	Technology intervention research
Down Syndrome	Heart conditions, sight and hearing problems, respiratory tract infections, skin problems and obesity	Language, cognition and memory	iPhones and iPads successfully used to teach individuals with DS (Buzzi, Buzzi, Perrone, Rapisarda, and Senette , 2016; Macedo and Trevisan, 2013; Macedo, Trevisan, Vasconcelos and Clua, 2015)
Fragile X syndrome	All males will have mild to moderate ID and about one third of females have ID.	Social and communication skills Anxiety and attention deficit disorder	Successful iPad interventions (Díez-Juan et al., 2014).
Autism	Asperger's syndrome, childhood disintegrative disorder and pervasive developmental disorder	Social interaction and communication.	iPod, iPhones and iPads used to teach individuals with Autism and other

		Sensitive to light, sound, taste, smell and touch	ID's (Kagohara <i>et al.</i> , 2013).
Foetal Alcohol Spectrum Disorder (FASD)	Mental and behavioural disorders, chromosomal abnormalities, congenital malformations, and deformities	Language, learning, attention and memory	Very little research

2.3 Technology, Media and Intellectual Disability

It is important to consider the broader background and the complex relationships between technology, media, and society as they apply to the specific domain of this research study. The digital divide framework, a component of Social Shaping Theory, is explored in the context of how it applies to Persons with Intellectual Disability (PwID). The importance of digital literacy for PwID will be discussed in this context. The topic of cybersafety and cyberbullying in particular will then be explored in detail for this target user group as it is the main topic to be included in the instructional *CyberSafe* application. These topics and the relationships between them are rich and have many different features. The final section concludes with Human Computer Interaction and how it relates to this *CyberSafe* research study.

2.3.1 Social Shaping of Technology

The social shaping of technology (SST) has become a broad umbrella term to cover a variety of theoretical and methodological perspectives in the social sciences (Dutton 2012). The continuing advance of digital research makes it ever more important to strengthen the role of the social sciences in this area of multi-disciplinary research, policy, and practice. The SST perspective encourages researchers to analyse how technologies mediate social processes and how they may reinforce or challenge existing social structures and inequalities. According to the SST perspective, technology is seen as a product of social processes and negotiations among various actors, including users, designers, policymakers

and other stakeholders (Dutton, 2012). The concept of technology affordances refers to the possibilities for action that a technology offers to users, shaped by both the material properties of the technology and the social context in which it is used (Norman, 1999). Unlike technological determinism, which views technology as an autonomous driver of change, the affordance perspective highlights the reciprocal relationship between humans and technology. Technologies do not determine behaviour but instead provide a range of potential uses that are actualised differently depending on users' goals, practices, and social environments (Hutchby, 2001). For instance, while a social media platform may facilitate global communication, how users engage with that affordance varies across cultural and demographic lines. Thus, affordances are not fixed but are dynamically realised through interaction, emphasising the socio-material nature of technological use (Faraj and Azad, 2012). The SST perspective builds on this view by emphasising that technological development and use are deeply embedded in social, cultural, and institutional contexts (MacKenzie and Wajcman, 1999). SST rejects the idea that technological progress is inevitable or solely driven by technical innovation, proposing instead that social actors, including users, designers, and organisations, actively influence the direction and form of technological change. This aligns with the affordance perspective by showing how the potential of a technology is co-constructed through processes of negotiation, interpretation, and adaptation (Orlikowski, 2000). For example, collaboration platforms like Microsoft Teams are shaped not only by design features but also by evolving norms around remote work, managerial expectations, and user feedback. Together, these frameworks highlight the entangled relationship between society and technology, showing that technologies are not neutral tools but active participants in social life.

This *CyberSafe* study explicitly rejects technological determinism, which positions technology as a primary driver of social change. The deterministic approach fails to explain why digital innovations often exacerbate inequalities rather than resolve them, particularly for vulnerable groups such as PwID. In the context of PwID, a deterministic view might suggest that increased access to digital tools will automatically lead to greater inclusion, safety, or independence. However, empirical evidence consistently shows that outcomes depend on how technologies are designed, supported and embedded within social systems (Seale, 2014; Judge, 2020). By contrast, SST allows for a more nuanced understanding of

why well-intentioned technologies may fail in practice, and why policy initiatives, such as digital upskilling agendas, do not automatically translate into meaningful digital inclusion. Social justice theory (Bell, 2016), which will be discussed in more detail in the next section, emphasises the fair and active involvement of individuals from all social backgrounds including marginalised groups like PwID in shaping a society that reflects and supports their diverse needs. Achieving social justice requires a participatory and democratic approach, one that values human diversity, respects group differences, and promotes individual agency and the collective ability to drive social change through collaboration (Feenberg, 1999; Bijker, 1995). Feenberg's (1999) concept of democratic rationalisation emphasises the importance of inclusive participation and the involvement of diverse social groups in shaping technological systems, thereby enabling marginalised voices like PwID to influence technological outcomes. Complementing this perspective, Bijker (1995) demonstrates how technological artifacts emerge through the interactions of socially relevant groups, highlighting the role of interpretation and collaboration in technological development. Earlier foundational work by Pinch and Bijker (1987) further establishes that technological meanings are socially constructed through the negotiations of different social groups, reinforcing the argument that democratic engagement and collective agency are central to shaping technology in ways that advance social justice.

While Actor Network Theory (ANT) also rejects technological determinism, it is not adopted as the primary framework in this research study for several reasons. Even though ANT takes into account the plurality of human actors (Bødker, 2006) and sees the researcher as a situated, accountable participant rather than an external observer, it treats human and non-human actors as analytically equivalent and thus risks obscuring structural inequalities, power relations, and ethical responsibilities (Latour, 2005) that are central to research involving PwID. In contexts where PwID experience dependency, vulnerability, and reduced agency, it is crucial to retain an explicit focus on human experience, social justice, and institutional accountability. ANT is often criticised for its limited engagement with concerns, such as inclusion, rights, and policy effectiveness (McLean and Hassard, 2004). This *CyberSafe* research seeks not only to describe networks of actors, but to critically examine gaps between policy and practice, assess the effectiveness of digital safety interventions, and inform more equitable design and governance practices. SST, with its explicit attention

to social values and power, is better suited to these aims. Specifically in terms of this *CyberSafe*'s research, it can be argued that there is a social context that needs to be considered. During the early stages of this research, the then Minister for Further and Higher Education in Ireland, (2020-2022), Simon Harris, was a champion for students with intellectual disabilities and autism. Through his political and educational initiatives, he highlighted the need for digital upskilling of this user group. Political initiatives and interventions like this implicitly illustrate the essence of social shaping theory which argues that technology is not a neutral phenomenon but more an embodiment of social, cultural, political values and choices. In this context, social shaping is a useful theoretical construct as it helps to frame the understanding of public discourse in relation to technology and the role of different actors and factors in shaping technological artefacts and affecting technological change. For example, the expense and accessibility of technology can be problematic for users with ID, which in turn shapes design choices, functionalities, and effects. As highlighted by Enable Ireland in 2016, technology can be too expensive to fund for the person with ID or their family. Their recommendation is for an Assistive Technology (AT) passport which would help to empower individuals in deciding what AT would suit their needs. This solution would also reduce the cost of providing AT in Ireland. A huge gap has been identified between policy and practice. Some of the reasons for this gap is that funding for AT comes from several different departments as well as other sources and there is no collaboration between the agencies involved. The service is not delivered in a consistent manner throughout the country. The service is not centred on the specific needs of individuals and most importantly, there is a lack of research into the effectiveness of AT solutions.

The social shaping perspective has practical implications for the design, implementation, and governance of technology solutions. This *CyberSafe* research study recognised the importance of anticipating and addressing potential social, cultural, and ethical implications of internet safety for PwID early in the design and development stages. It adapted inclusive and participatory approaches that involve diverse stakeholders in decision-making processes. Factors such as social norms where young adults communicate via social media platforms, power dynamics (between parent and a young vulnerable adult), and institutional arrangements influence the adoption, adaptation, and diffusion of

technologies by PwID. The role of supporters and champions in facilitating the use of technologies in all educational settings (Judge, 2020) and particularly by adolescents and adults with learning disabilities is becoming more prevalent (Seale, 2014; Murphy, 2024). The importance of designing for people with ID is highlighted by Dekelver *et al.* (2015) who suggest users with ID are at risk of further exclusion from society. Social shaping theory provides a valuable lens through which to examine and analyse how technologies mediate social processes and how they may reinforce or challenge existing social structures and inequalities, thus shedding light on why there is a large gap between technology for mainstream users and for the PwID.

2.3.2 Social Justice Theory

Social Justice Theory (SJT) offers another key framework for understanding how instructional interventions can address systemic inequalities experienced by marginalised populations, including PwID. Grounded in principles of fairness, equity, and inclusion, the theory emphasises the ethical responsibility of institutions and educators to reduce disadvantage and promote meaningful participation (Bell, 2016). In digital contexts, this framework is particularly relevant to cybersafety education, as PwID face heightened online risks alongside limited access to accessible cybersafety resources. Rawls' (1971) theory of *justice as fairness* provides a foundational perspective on equity for PwID. His first principle asserts that all individuals are entitled to equal basic liberties, including access to information and participation in social life. In contemporary societies, these liberties extend to digital participation and the ability to engage safely in online environments. However, standard cybersafety education often relies on abstract language, complex scenarios, and implicit social norms, which can exclude PwID (Chadwick *et al.*, 2019).

Rawls' second principle, encompassing the *difference principle and fair equality of opportunity*, holds that inequalities are only justifiable when they benefit the least advantaged members of society. From this perspective, policies and technological systems that fail to provide reasonable accommodations or that systematically exclude PwID violate fair equality of opportunity, as they prevent individuals from accessing positions and social goods on terms comparable to others (Rawls, 2001). Consequently, justice requires not merely formal equality, but the intentional design of social institutions and support

structures that prioritise the needs of PwID, ensuring that inequalities in resources and decision-making power are arranged to their advantage rather than reinforcing existing disadvantage. Therefore, designing digital interfaces to meet the specific needs of PwID is not preferential treatment but a requirement of justice. The European Accessibility Act (enacted in Ireland June 2025) requires digital interfaces (like websites and apps) to be easy to understand, predictable, and usable for PwID, not just physically accessible. This means using clear language, simple navigation, consistent layouts, and compatibility with assistive technologies so everyone, including PwID, can use digital services independently. Cybersafety applications designed with simplified language, visual supports, repetition, and scaffolded learning align with Rawls' emphasis on compensatory measures that reduce structural disadvantage.

While Rawls focuses on distributive justice, Bell (2016) extends social justice theory (SJT) into educational practice, where she emphasises equity over equality and the empowerment of marginalised individuals. Within this framework, disability is understood as a product of exclusionary systems rather than individual deficit, shifting responsibility toward inclusive educational design. Research indicates that PwID are often positioned as passive recipients of online protection, rather than active digital citizens capable of making informed decisions (Seale, 2014). A social justice approach challenges this narrative by promoting instructional designs that support self-determination, decision-making, and confidence. Involving PwID in co-design processes further ensures that educational applications reflect their lived experiences and priorities. SJT also contextualises online vulnerability within broader systems of digital exclusion and ableism. In summary, Social Justice Theory, as articulated by Rawls (1971) and Bell (2016), provides a strong social justice theoretical foundation for inclusive cybersafety education. Rawls' principles justify differentiated and accessible design to protect the least advantaged, while Bell's educational framework emphasises empowerment, inclusion and participation.

2.3.3 Digital Divide Theory

The digital divide theoretical framework examines the disparities in access to and use of digital technologies among different populations (Van Dijk, 2005). Digital divide research is typically divided into two stages. The first stage (1999–2002), concentrated on

the concept of physical access to technology: i.e., devices to connect to the internet. This early research around “first-level barriers” looked at differences in access to and utilisation of digital technology by different groups of people based on gender, geographical location, income level and intellectual ability. It emphasised how socioeconomic inequities can be made worse by disparities in access to technology and may have major effects on a number of aspects of life, such as access to information, social involvement, employment, and education. Digital Divide theory seeks to understand the factors (e.g economic status, education) that contribute to these differences and their implications for social, economic, and educational opportunities. It is clear from the literature (Lussier-Desrochers et al., 2017; Plichta, 2019; Alfredsson Ågren, Kjellberg and Hemmingsson, 2020) that access to technology and being able to interact with user interfaces can be one of the main challenges impeding adults with intellectual disability and their interaction with digital artefacts.

In the second phase of digital divide research, researchers looked beyond physical access skills (Van Dijk and Hargittai, 2002), to the full usage of technology interfaces on a device. Hargittai (2002) invented the term “second-level divide” for this new phase of research. Van Dijk (2005) coined the term deepening divide to highlight that the problem of digital inequality begins when digital media technology is used in all aspects of daily life. From 2005 to 2015, the second-level divide became the focus of most digital divide research. Today, the ubiquitous use of technology means that people of all backgrounds and ages are using social media that Statista (2021) argues has become the biggest internet phenomenon of all internet innovations over the last ten years. In 2020, global social media usage rate was 49 percent, with East Asia and North America having the highest usage at 71 and 69 percent respectively, followed by Northern Europe at 67 percent (Statista, 2021). The phenomenal growth and popularity of social networking sites involves opportunities as well as risks for all of the population. Policy makers, researchers and practitioners are striving to maximise the opportunities to benefit and minimise the harm from the Internet to children in particular (Smahel *et al.*, 2020). These issues affect young people today, and especially young people with intellectual disabilities. Policymakers and practitioners need to consider both the positive and potentially restrictive aspects of support to create inclusive digital environments for PwID, focusing on educating and supporting them on how to be

safe online and how to promote digital literacy and inclusion while being aware of its risks (Murphy *et al.*, 2024).

2.3.4 Digital Divide Theory applied to persons with ID (PwID)

The literature highlights the existence of a digital divide within the context of individuals with intellectual disabilities (Seah, 2020). A widespread digital disparity is experienced by many people with intellectual disabilities as a result of limited Internet access, support, training and accessible interfaces. The Covid-19 pandemic interrupted the educational experience of all students (Judge, 2021; Judge, 2024) and was particularly acute for those with special needs when it came to accessing online educational resources. The social, mental, and physical strains brought on by Covid 19 and the different lockdowns affected individuals with ID in particular (Courtenay and Perera, 2020). It highlighted the importance of special needs users accessing online educational resources. An international review of empirical studies published between January 2019 and June 2021 demonstrates a lack of prior support and training for both PwID and support and care staff (Chadwick *et al.*, 2022). There was a national outcry in the media in Ireland about the lack of appropriate support and educational services for children and teenagers with special needs during the various Covid 19 lockdowns as well as those from socially disadvantaged communities (Shonfeld, Yildiz and Judge, 2020; Judge, 2021). The families and carers were particularly vulnerable because respite care, residential schools, day services were closed due to the ongoing Covid 19 pandemic (Courtenay and Perera, 2020).

The number of internet users increased by nearly 10% worldwide during 2020 (Statista, 2021). This is likely due to the pandemic. However, it is unclear whether PwID specifically, have experienced this upward swing (Chadwick *et al.*, 2022). PwID, especially those with higher support needs, of an older age, from lower socio-economic backgrounds, could have experienced more digital exclusion (Seah, 2020). Alternatively, the lockdown may have acted as a catalyst, encouraging persons with an intellectual disability, carers and support services to adopt digital devices and start digital participation (Willner *et al.*, 2020). This however has raised concerns about security and safeguarding and emphasises the need to analyse the benefits and barriers of ICT use for individuals with intellectual disabilities, including the potential for empowerment and risks of abuse and exclusion (Plichta, 2019).

There are challenges associated with digital inclusion for individuals with intellectual disabilities, including access to digital devices, sensorimotor and cognitive requirements, and comprehension of codes and conventions (Lussier-Desrochers et al., 2017). When individuals with intellectual disabilities have access to the Internet, but only use it sparingly (for example, to view movies and play games), this digital inequality is also evident. Overall, this research highlights the need to address the digital divide and promote digital inclusion for individuals with intellectual disabilities. Alfredsson Ågren, Kjellberg and Hemmingsson et al. (2020) reported individuals with ID had significantly lower access to internet-enabled devices when performing online activities compared to neurotypical individuals with the exception being playing games. For example, in the European Union, people with intellectual disability have a 62% lower chance of having online access in their homes (Scholz et al., 2017). After performing a systematic and critical evaluation, Glencross *et al.* (2021) emphasise that far less emphasis has been paid to the advantages of Internet use for people with intellectual disabilities than the risks. They found that social media/social networking was the most frequently reported type of internet use (23%), mental discomfort was the most frequently reported internet danger (24%), and friendships and social connection were the most frequently reported internet benefits (33%).

Newer technologies have the potential to create an easier and more fulfilled life for people with ID, especially social media (Caton and Chapman, 2016). Social acceptance was found to be more important to adolescents with ID than typically developing adolescents (Nader-Grosbois, 2014). Social media is used by people with ID to communicate. Some PWID used social media to communicate and comment on posts. However, most used it to look at pictures and videos or listen to music. Skype and WhatsApp were also used although less often than Facebook. People with ID are vulnerable when using social media, particularly due to their inability to use the privacy settings (Daems *et al.*, 2015). This highlights the need for educational training in this area for this user group. Caton and Chapman (2016) conducted a systematic review on the use of social media by people with intellectual disability. Results showed that some PwID are having positive experiences using social media in terms of friendships, development of social identity and self-esteem, and enjoyment. “However, barriers that stop people with intellectual disability from successfully accessing social media were identified such as safeguarding concerns, difficulties caused by

literacy and communication skills, cyber-language, cyber-etiquette, and accessibility (including lack of appropriate equipment” (Caton and Chapman, 2016, p.129). The researchers concluded that it is possible for people with ID to have a positive experience with social media. However, more research was needed in some problematic areas such as safeguarding, literacy and support.

Worldwide access to the internet is changing the world rapidly. Previous research highlighted the need for young persons with ID (PwID) for education on cybersafety and digital critical engagement (Wright, 2017; Buijs, 2017; Didden *et al.*, 2009). When considering the digital divide for users with intellectual disabilities, three other theoretical concepts have been identified that can potentially be applied as a lens to better interpret this issue. These are the Social Model of Disability, Capability Approach and The Human Rights framework.

1. Social Model of Disability: The social model of disability stresses that societal attitudes and barriers as well as an individual's impairments have a role in the development of disability. In this context, the digital divide for people with intellectual impairments can be viewed as a societal barrier that restricts their access to online resources and digital technologies. The UN Convention on the Rights of Persons with Disabilities came into effect in 2007. This convention recognises, as a basic human right that everyone should have equal access to the internet and thus be provided with equal opportunities (Giddens, 2006). Chiner, Gomez-Puerta, and Cardona-Molt (2017) reported more than half of the family and support workers they surveyed do not feel adequately prepared to cope with or prevent the cybersafety challenges for people with ID. Most of their internet safety information comes from family, family, and media. However they argue that more formal training should be provided. It should be noted that while the results of this study could not be applied widely, they are supported by the work of Chadwick, Quinn and Fullwood (2017). Furthermore, a report on educational staff perceptions by Pearson *et al.* (2019) revealed that, while staff have the commitment to develop and deliver more inclusive learning approaches, they are unaware of the various attainment gaps and barriers PwID face. They also do not have confidence in their own skills to point learners to support and are not satisfied with the current training and guidance specific to technology/digital media for teaching PwID.

The Covid-19 pandemic only exasperated this problem, with The European Association of Service Providers for Persons with Disabilities (2020) reporting that Covid-19 affected provision of social care and support services for those with disabilities worldwide. As service providers had to offer support online as much as possible to abide by pandemic guidelines (Zaagsma *et al.*, 2020; Courtenay and Perera, 2020; Smith *et al.*, 2022). In some case, the inability to access face to face support has impacted technology usage among PwID, including acquiring the critical skills needed for independence. Consequently, it was suggested that professionals increase virtual outreach to both users and families to identify specific needs required for support to be individualised. Specifically noted was the need to increase the deployment of support technologies that facilitates the autonomy of people with disabilities.

2. **Capability Approach:** The capability approach, developed by Amartya Sen, focuses on people's capacities and chances to live fulfilling lives (Frediani, 2010). It emphasises the significance of giving people the capacities (such as digital literacy skills and access to assistive technologies) to participate in society, particularly in the context of intellectual impairments and the digital divide. Some PwID internet users may be less likely than others to transform their online activities into offline resources, such as educational outcomes and social capital, which has recently been shown to also be a source of digital inequality. It has not been investigated to what extent individuals with intellectual disabilities are transferring their internet activities to offline resources.
3. **The Human Rights framework** underlines that having access to information and communication technology (ICT) is a basic human right. Denying people with intellectual impairments (PwID) access to digital tools can be seen as a violation of their freedom to learn, express themselves, and participate fully in society. Digital agency which is the capacity of individuals to make purposeful and autonomous choices in digital environments, is a crucial component of digital inclusion (Passey et al, 2018). The lack of tailored training and support often limits the opportunities of PwID to develop digital competencies, which are essential for participating in education, employment, and social life in a digitised society (Caton and Chapman, 2016). Without intentional efforts to empower individuals with ID to make meaningful choices in digital contexts, their digital agency remains marginalised. A cross cultural model by Shonfeld *et al.* (2020)

built upon a social justice perspective, recognises that digital inclusion is a key social justice concern in the 21st century. Inclusive design is not just about accessibility. It is about empowerment, participation, and agency (Seale *et al.*, 2017). The OECD's Digital Inclusion Framework emphasises that bridging the digital divide is essential for achieving social participation, economic opportunity, and improved well-being for all citizens, especially vulnerable groups (OECD, 2021). The principle of "*Nothing About Us, Without Us*" should guide all stages of technological development and implementation for people with intellectual disability (Charlton, 1998). This means actively involving PwID as co-designers, not merely as users or testers, ensuring that their voices, preferences, and lived experiences shape the tools intended for their benefit. Without their input, digital interventions risk being ineffective or even exclusionary.

In 2013, the World Health Organization (WHO) started an initiative to promote Global Cooperation on Assistive Technology (GATE). The goal of GATE is "to improve access to high quality, affordable accessible technology "for people with varying disabilities, diseases, and age-related conditions" (Boot *et al.*, 2017, p.1). People with ID have been identified as a user group who can benefit from assistive technology. However, GATE researchers recognise that the use of assistive products by PwID is a neglected area of research and practice, and offers considerable opportunities for the advancement of the health of people with ID and the fulfillment of basic human rights. The number of people with ID worldwide who have access to appropriate assistive products and which factors influence their access is still unknown. It is part of that GATE mandate to meet the needs of people with intellectual disabilities, a group who have been identified by GATE, as those who can benefit from user appropriate assistive technology.

Table 2 Concepts to act as a lens to better interpret this issue

Theoretical concepts	Main Ideas
Social Model of Disability	<p>Societal attitudes and barriers</p> <p>Not prepared to cope or prevent the cybersafety challenges</p> <p>Covid 19 pandemic exasperation and exclusion</p>
Capability Approach	<p>Focuses on people's capacities</p> <p>Transferring internet activities to offline resources.</p>
The Human Rights framework	<p>Denial is a violation of freedom to learn, and participate fully in society.</p> <p>GATE mandate</p>

2.3.5 Digital Literacy for PwID

Technology has become an increasingly integral part of daily living, and the adaptive skills required to understand and effectively use it have become essential for participating in modern society. Digital literacy (DL), which is an evolving concept, refers to an individual's ability to successfully and critically navigate, evaluate, and communicate information using digital technologies. It involves the practical ability to operate digital tools and platforms in addition to the cognitive competence to interpret and apply digital content in meaningful and contextually relevant ways (UNESCO, 2018). As stated by the European Commission (2022), digital literacy encompasses five core areas: information and data literacy, communication and collaboration, digital content creation, safety, and problem solving. These skills are known as Digital Literacy Skills (DLS).

Examples of these five dimensions include:

- sending and responding to emails using an appropriate tone and etiquette;

- researching information online and being able to critically judge the credibility of the source;
- using digital platforms to share or create information such as presentations;
- social media posts or blogs, being aware of personal data and privacy in digital environments;
- the ability to identify and resolve common issues with digital devices or platforms.

Digital literacy is becoming increasingly important as ICT advances (Yu, 2025). Digital literacy can be a valuable enabler for PwIDs to bridge the digital divide. It can support their skill development, enhance their communication and social interaction abilities. However, they face specific challenges when it comes to accessing and using digital technologies. They require appropriate support and training to ensure they have the necessary skills and knowledge to use technology effectively and safely as responsible digital citizens. As digital technology has allowed for broader opportunities for all, the importance of digital literacy has been demonstrated to promote internet use among PwID (Caton and Chapman, 2016; Chadwick *et al.*, 2013). For example, digital literacy for PwID may include logging into a website, using a web browser, blogging and understanding appropriate cyberlanguage and etiquette (Caton and Chapman, 2016). By learning digital literacy skills from ICT programmes, PwID may have a more positive experience, leading to their increased Internet use.

2.3.5.1 Digital literacy (DL) skills suitable for PwIDs

Several studies have focused on examining a modified or condensed version of functional digital literacy (DL) skills suitable for PwIDs (Cihak *et al.*, 2015; Venkatesan, 2024). These studies have specifically looked at basic skills such as sending and receiving email messages, organising social bookmarking, accessing useful websites for downloading, revising, and uploading documents. Venkatesan (2024) conducted a meta-analysis of research on how PwIDs access technology and found that functional DL skills were considered the most relevant level of skill for PwIDs. The DL research was conducted with PwID on various devices including Windows desktop computers, laptops, and iPad tablets.

Functional DLS are a set of basic digital skills that involve sending and receiving emails, and uploading and sharing documents (Cihak et al., 2015). Acquiring these basic technological skills provides PwID with the opportunity to connect with others, manage day-to-day living, and engage in hobbies. Being unable to independently navigate the digital landscape can be very isolating for PwID, as it is so integrated into modern lifestyles. As inclusive post-secondary education for students with ID becomes more prevalent in colleges and universities, there is a growing emphasis on academic enrichment, socialisation, independent living skills, integrated work experiences, and career skills. There is an increasing need to integrate digital skills into their education to enable them to effectively use various technology devices such as computers, tablets, smartphones, and I-Pads for various purposes. International Research conducted by Galanciak, Weiss and Judge (2018) as part of the Erasmus+ Micool Project, illustrates both the benefits of using iPads to support the education of students with special needs as well as the challenges in terms of teachers training needs and digital competency. Further research conducted by Baxter and Reeves (2022) argues for the inclusion of DL training programmes in secondary-level education and recommends the skills that should be included in these programmes, and how special education teachers can teach them. These researchers recommend Digital Literacy Skills (DLS) that range further than Functional DLS, which had previously been considered the appropriate skill level for PwIDs. These skills can be divided into three categories: Internet and Device skills, electronic calendars skills, and software skills. In order to master Internet and Device skills, the researchers recommend that PwIDs be trained on how to check, create, and delete messages, including emails, answer and make phone calls, and log in and out of accounts. This specifically includes how to create, remember, and enter passwords. A structured and individualised teaching approach that could most effectively help PwIDs develop these skills can be achieved with task analysis methods, where each skill is put into smaller, simpler steps. These steps should be demonstrated by educators or with the help of visual aids, depending on the individual's learning needs. It is crucial to incorporate DL skills into the curriculum for PwIDs to equip them with the ability to navigate online risks and safely handle potential dangers encountered in virtual settings (Holzman and Thompson, 2023).

2.3.5.2 Support from others

Björnsdóttir *et al.* (2024) highlight that people with intellectual disabilities lack access to computer training opportunities and therefore do not have the chance to develop digital skills throughout their life. Their mixed-methods study conducted in Iceland found that lack of access to technology was often linked or as a direct result of parental or caregiver enforced barriers. With a random sample of 809 participants, participants were reached via phone, mail and in some cases online, with 61% of participants answering independently. Through both surveys and interviews, research found that those with intellectual disabilities were often told by caregivers that the internet was not 'for them'. This curtailment of internet access is often presented as a safety issue i.e., a way of protecting PWID from dangers online. The researchers state that these limitations and disparities stem from ableist beliefs about the abilities of PwID. Societal attitudes towards digital inclusion are important for internet use. It is not only a lack of access to smartphones, computers or tablets that limit those with intellectual disabilities, but societal assumptions. Negative attitudes towards technology, such as computer anxiety, have been shown to decrease one's desire to access the Internet (Van Dijk *et al.*, 2005).

Those PwID who grew up using ICT in their everyday life, particularly adolescents, will have better digital literacy as they are naturalised netizens (Thirumanickam *et al.*, 2024). Despite not using computers, many of the PwID participants in the Björnsdóttir *et al.* (2024) study owned smartphones and were able to use different applications and acknowledged that the use of technology allowed them to feel more independent. Access to and use of the internet for PwID can be encouraged through a digital support network. This can be defined as support from family members, friends, colleagues and professionals with regard to accessing and using the internet. PwID can seek support from others when learning how to use a digital device or troubleshooting. For example, if the families of PwID are unfamiliar with ICT, these adults may have limited opportunities to use digital technologies (Barlott *et al.*, 2020). Moreover, if PwID live with older family members, they may be the first in their family to use ICT and possibly receive less support regarding the use of digital devices (Perkins and LaMartin, 2012).

Fortunately, there has been a steady increase in the digital skills of PwIDs in recent years. A South Korean study conducted by Kim and Lee (2020) found that out of 298 participants, 80% had an active internet connection. It was found that 81% of participants had their own smartphone with many having a combination of laptops and computers. The study found that the participants of the study were very active online. Internet use patterns revealed that PwID use the internet mostly for recreational purposes such as watching television or browsing the internet rather than for work or study purposes. Participants perceived fewer benefits of using the internet regarding increasing their knowledge and more benefits for contacting friends and family.

2.3.5.3 Digital Literacy Skills training for PwID

As PwID have complex learning needs, traditional teaching methods can cause difficulties. Assistive technologies can help to foster and promote their learning process. The use of AT in special education settings has been shown to improve the quality of education by tailoring it to individual learning needs (Cihak et al., 2015; Garnier, 2025). Assistive technology also supports the development and application of digital literacy skills, particularly for people with intellectual disabilities, ensuring equitable access to digital literacy (Charles-Zalakoro, 2025). Thirumanickam *et al.* (2024) found that their effort to train adults with intellectual disabilities to use social media resulted in increased social media use following training. In future, more internet training should be implemented for PwID so that they too can reap the same benefits as neurotypicals.

In conclusion, there has been much research advocating for the development of programmes to help PwIDs acquire DLS, as they have become an essential part of daily life. This section covered a variety of barriers and facilitators to PwIDs and the development of DLS. The current field of research has focused on the key DLS relevant to PwIDs, and how to implement DLS training into education. Important challenges, such as cybersafety, the independent navigation of digital spaces, and the role of caregivers are highlighted. Parents and caregivers should be included in any digital literacy training targeting people with intellectual disabilities to ensure a supportive nurturing environment is given to them when learning about ICT. As caregiver concerns, such as cybersafety, often posed as a hindrance to PwID's digital inclusion, it is important that digital literacy programs address online safety

specific to PwID while educating them about potential risks, privacy setting and safe online practices (Venkatesan, 2024).

2.3.6 Cyberbullying

2.3.6.1 General population

The term “Cyberbullying” was first coined in 1999 (Englander *et al.*, 2017). However, there is no general consensus on what defines cyberbullying due to the main characteristics of bullying (intent, repetition, and power imbalance) not always translating well to a digital medium (Beltrán *et al.*, 2018). The majority of research on cyberbullying consists of inconsistencies and exaggerated claims due to multiple studies measuring cyberbullying using various methods. Despite this lack of clarity, the literature generally accepts the conceptual definition of cyberbullying as “wilful and repeated harm inflicted through computers, cell phones, and other electronic devices” (Hinduja and Patchin, 2015, p.145). Another shorter definition is that cyberbullying refers to harmful repeated behaviour with the intention to cause damage through the use of technology (Heiman and Olenik-Shemaesh, 2015). Kowalski *et al.* (2014) reported cyberbullying is reliably correlated with traditional bullying. Slonje and Smith (2008) reported that, while traditional bullying usually does not continue into the home, cyberbullying can, and as such victims may feel unable to escape. Multiple studies have reported that cyberbullying independent of traditional bullying can have a strong emotional impact, which can cause more harm than traditional bullying (Cross, Lester and Barnes, 2015). Houchins, Oakes and Johnson (2016) found, in a meta-analysis study, a clear gap in studies on bullying for students with disabilities is the lack of focus on cyberbullying. Unfortunately, researchers are still struggling to design effective programmes to reduce cyberbullying (Englander *et al.*, 2017).

At the Anti-Bullying Research Centre (ABC) in Dublin City University (DCU), Foody, Samara and Calbring (2015) conducted a meta-analysis of 39 published cyberbullying studies in Ireland and found a cybervictimisation rate of 13.7% for primary and 9.6% for post-primary students. Foody *et al.* (2019) conducted more recent research with a sample of Irish adolescents (aged 12- 16). The results revealed that 12.4% of post-primary students were bullied online; 2.9% of students were both targets and perpetrators of cyberbullying and only 1.5% of adolescents admitted that they bullied others online. In May 2020, ABC at DCU

were partners in a European wide research study in partnership with the Joint Research Centre of the European Commission (JRC) involving 11 EU countries. This study, conducted by the ABC, investigated the experiences of Irish children and families during the Covid-19 lockdown (Milosevic, Laffan and O’Higgins Norman, 2020). Results showed that 28% of children in the sample reported to have been the target of cyberbullying during the lockdown, while 50% reported to have seen others being cyberbullied (bystander role). The younger in age they were, the more likely they were to have been the target of cyberbullying. Males experienced significantly more frequent cyberbullying since lockdown. This may have been due to their high level of engagement in online gaming. Sixty-six percent (66%) of all children between the ages of 14- 16 years experienced significantly more cyberbullying (as compared to pre-lockdown) through instant/private messaging services such as WhatsApp, Viber or Telegram. On a positive note, Livingstone and Smith (2014) found that these kinds of risks are balanced by an equal growth in safety awareness and initiatives. Livingstone and Stoilova (2021) described a framework of four types of online risk:

- (1) online content—the individual is the recipient of mass-distributed content, for example pornographic content;
- (2) online contact— the individual is the participant in an interactive scenario , for example being cybervictimised through cyberbullying;
- (3) online conduct—the individual is an actor, for example perpetrating cyberbullying;
- (4) online contract—the individual accepts terms and conditions, which allows for security or privacy risks, for example when one’s digital profile and information is subject to identity theft or fraud.

This framework was developed from studies with young people without intellectual disabilities, hence this framework should be applied cautiously. The literature is still relatively sparse in terms on online risks for people with intellectual disabilities (Chadwick, 2019). Livingstone and Stoilova’s (2021) framework has been applied to PwID previously and provides a framework for considering different risk types (Chadwick, 2022). Online contact risks are the most discussed risk type by PwID. Specifically, cyberbullying victimisation,

defined as being a victim of actions via electronic communication intended to cause harm, is the main risk that has been empirically investigated throughout PwID literature. However, as most of these studies adopted a quantitative approach (Chiner *et al.*, 2017; Didden *et al.*, 2009; Wright, 2017), the lived experiences of online risk, which can be explored effectively using qualitative approaches, has been largely neglected.

2.3.6.2 ID population

Iglesias, Gómez Sánchez and Alcedo Rodríguez (2019) reported that frequency rates of those experiencing cyberbullying are similar to the neurotypical population despite people with ID using social media less. They reported on cybervictimisation across three groups of young people, neurotypical, those with Aspergers Syndrome (a form of autism) and those with Intellectual Disability (see Table 3 for their detailed breakdown of the percentage of people subjected to some form of cybervictimisation). Participants included 181 adolescents with a mean age of 16 years old (SD=3.7). A total of 25% were young people with ID (n=45) and 17% (n=31) were young people with AS. These two study groups thus totaled 76 people (42%). The comparison group (i.e., neurotypical development) accounted for 58% of the sample (n=105). These 181 young people completed the “Cyber-aggression Questionnaire for Adolescents”, the “Cyber-victimization Questionnaire for Adolescents” and a questionnaire on social media and new technologies. The result showed that the percentages of use of new technologies (61% tablets, 93% computers, 97% mobiles) are similar among 3 groups but adolescents with Asperger syndrome or ID have been using the devices more in recent times. However, their uses are more limited. They also use social media less; the group with Asperger syndrome uses it the least, possibly due to their social and communication difficulties. Iglesias *et al.* (2019) found no significant differences in the frequency of cyberbullying. The types and rates of cybervictimisation incurred are highlighted in Table 3. Despite young people with ID using social media less, the frequency of cyberbullying is similar to their peers. The observed prevalence of cyberbullying is higher than that mentioned in previous studies in which informants were not the youths themselves.

Table 3 Percentage of people subjected to some form of cybervictimisation

Items	Neurotypical	AS	ID
Impersonation			
1. Someone has impersonated me on the Internet, posting comments as if they were me	12.4	6.4	11.1
12. Someone has impersonated me on <i>Twitter</i> or <i>Facebook</i> , creating a fake profile with which to ridicule me	1.9	6.4	4.4
18. Someone has gotten my password and sent annoying messages to someone I know, as if it were me, to get me into trouble	8.6	6.4	6.7
Visual-sexual			
2. Without my consent, someone has taken photos or made video recordings of me with sexual content and has disseminated them via mobile phone or the Internet	2.85	6.4	13.3
9. Without my permission, someone has disseminated, via mobile phone or the Internet, compromising pictures or videos that I had taken or made myself	1.9	3.2	2.2
14. Someone has pressured me into doing things that I did not want to do, threatening to disseminate my intimate conversations or images	2.85	3.2	11.1
Visual-mocking/happy slapping			
3. Someone has modified photos of me and posted them on the Internet or sent them via <i>WhatsApp</i> to hurt or make fun of me	14.3	9.6	13.3
6. Without my permission, someone has posted on the Internet or sent via <i>WhatsApp</i> groups real, compromising pictures to hurt or make fun of me	6.7	9.6	11.1
10. Someone has beaten me, had it recorded, and then disseminated the recording	0.9	–	6.7
15. Someone has forced me to do something humiliating, had it recorded, and then disseminated the recording to mock me	2	3.2	2.2
Verbal			
5. I have received calls on my mobile where the caller stays silent, I guess to annoy me	47.6	38.7	11.1
7. I have received calls to insult or mock me	5.7	13	17.8
8. Someone has picked on me, insulted me or made fun of me on social media	6.7	22.6	22.2
11. I have received insults via text message or instant messaging programs (e.g., <i>WhatsApp</i>)	12.4	9.6	24.4
17. I have received anonymous calls to threaten or frighten me	5.7	3.2	11.1
19. Someone has posted false rumors about me on social media or has spread them on <i>WhatsApp</i>	12.4	6.4	11.1
Online exclusion			
4. I have been removed from, or not accepted on, a social network or on <i>WhatsApp</i> , without having done anything, just for being me	9.5	16.2	13.3
13. Someone has made false complaints about me on a forum, social networking site or online game, and this got me kicked out	5.7	3.2	8.8
16. People have conspired to blank me (ignore me) on social media, <i>WhatsApp</i> ...	2.9	9.6	15.6

Note Neurotypical: AS = Asperger syndrome: ID = Intellectual Disability

(Source: Iglesias, Gómez Sánchez and Alcedo Rodríguez, 2019, p.34)

Normand and Sallafranque-St-Louis (2016) identified eight research respondents with ID, who reported online cyber bullying in the form of; being insulted, having false rumours spread about them and being targets for sexual exploitation. The relationship between cyberbullying and IQ, self-esteem, depression and computer use frequency was highlighted by Didden *et al.* (2009) who reported for example, the higher the young person's IQ, the more likely they are to be cyberbullied. It is argued that without support, the frequency of cyberbullying will drastically increase as PwID avail of technology more. Buijs

(2017) recommend that carers and professionals should discuss the risks and benefits regularly with young adults with learning disabilities, particularly those with poor judgment.

A literature review conducted by Martinez-Cao *et al.* (2021) identified a clear need for targeted interventions to develop the socio emotional skills of people with ID to address cyberbullying. Their literature review identified over 527 citations and research articles on studies undertaken between 2007 and 2019, exploring cyberbullying with young people with intellectual disabilities, aged between 18 years to 40. This included retrospective studies with participants over 18 reporting on their experiences throughout childhood and adolescence. However, common weaknesses in many of the studies were identified. This may explain some the disparities in previously described studies. Different methodologies were employed, which greatly hindered the comparability of data within comparison studies. The samples used were extremely diverse in nature for example in terms of age, context and level and complexity of ID, and several studies shared the same participants and some of the articles or studies did not separate out the number of students, with parents /support workers, teachers participating. How to tackle cyberbullying, keeping information private in social media environments, and coping with harmful sexual material or scams seem to be important areas to cover in any proposed educational application. Moreover, there is a dearth of instruments to assess cyberbullying specifically tailored to the needs of research respondents with ID.

2.3.7 Human Computer Interaction and Interaction Design

Human computer interaction (HCI) is an academic discipline contributing to interaction design with a focus on “design, evaluation and implementation of interactive computing systems for human use” and the study of phenomena surrounding them (Preece, Sharp and Rogers, 2015, p.10). HCI acknowledges the importance of users as participants when carrying out studies in this area (Halskov *et al.*, 2015). Design of technology is improved with users involved due to their valuable information and expertise.

Interaction design is defined as “designing interactive products to support the way people communicate and interact” in their lives (Preece, Sharp and Rogers, 2015, p.8). Interaction design uses theory and research to design user experiences within a specified context and directly relevant to the intended task. The main difference between interaction

design (ID) and human-computer interaction (HCI) is one of focus. Historically, HCI had a narrow scope and focussed on the design and usability of computing systems. Interaction design was perceived as being broader, concerned with designing the user experiences for all types of technologies, systems, and products. Within HCI development, the user-centred approach to development is being emphasised more and more (Sharp, Rogers and Preece, 2019). User-centred design considers a system well designed when the real users and not the technology are the driving force in development. Hassenzahl and Tractinsky (2006, p. 91) highlighted that 'user experience' (UX) had become fashionable in the field of human - computer interaction (HCI) and interaction design. They keenly observed that "the term promised change and a fresh look, without being too specific about its definite meaning". The emphasis here is on the value the product adds to the user and the business. Consequently, user experience is much bigger in a business sense than the user-centred design process or methodology.

Previously, the Human Computer Interaction field (HCI) studied the interaction between the computer and the user. In recent times, it has changed to studying how humans interact with each other via various devices and accross the internet. Humans use sound, touch and gesture when interacting with one another. Using audio, video, text and images in multi-modal interfaces aims to make the HCI experience more like interaction between people.

2.4 Cybersafety for target user group

Cyberbullying, financial and sexual exploitation are some of the challenges young adults with learning disabilities encounter in social media involvement (Holmes and O'Loughlin (2012). Chadwick (2019) highlights the common types of cybercrime experienced by people with ID. The most common cybercrime against young people with ID include exposure to harmful manipulative, or exploitive content such as harmful sexual material or scams; negative content online such as being bullied , or groomed for sexual contact, or radicalisation; and engagement, in antisocial or criminal behaviour, such as trolling, bullying or flaming which is sending inappropriate content. PwID have online contact risk experiences in the form of image-based sexual abuse through receiving unwanted sexual messages and requests to send sexual images of themselves on the Internet (Holmes and

O'Loughlin, 2014). Coco's law, introduced in Ireland in 2021, refers to the Harassment, Harmful Communications and Related Offences Bill introducing two new offences to deal with the non-consensual distribution of intimate images with a penalty of an unlimited fine and/or up to seven years imprisonment. Buijs *et al.* (2017) describe case vignettes which were actual clinical cases of eight adults (aged 18-40) with ID. Severe sexual and financial exploitation, had occurred in the cases of these eight adults. Jenaro *et al.* (2018) reported among 269 participants with ID from Mexico, Chile, and Spain, that 15.2% had been cyberbullied with 41.5% of these individuals being cyberbullied every day. Of these participants, 53.7% had been impacted negatively and 14.63% reported doing nothing about cyberbullying. Having an intellectual disability and thus being not being neurotypical was cited by 97.7% as the main root of the cyberbullying. The cyberbullying mainly happens in educational settings (46.67%), outside educational environments (31.11%), and in social clubs (15.56%).

Kowalski *et al.* (2016) reported people with ID may not be able to judge if their experience is cyber victimisation and for people with ID, the negative outcomes are more pronounced than the neurotypical population (low self-esteem, high depression). These findings emphasise the gap and need for further studies on cybersafety for PwID, as well as the need for implementing educational prevention initiatives. Borgström, Daneback and Molin (2019) conducted a review to research and analyse results in the area of young people with ID with the focus on social media and online social activities. They aimed to investigate the research implications for the development of support resources and future research. From a starting number of 457 papers, and after using strict criteria for selection, they produced a qualitative meta-summary to capture their results. Only twelve peer-reviewed papers between 2001 and 2017, fulfilled their strict criteria. Table 4 displays a concept matrix (Watson and Webster 2002) identifying the main themes. They identified six main themes: opportunities, risk and vulnerability, sexuality, identity, barriers and support. Some focused only on the views of professionals and parents and their perspectives of young adults aged 18–20 and 16–21. Others focused on the young people themselves. Borgström, Daneback and Molin (2019) highlight that young people with ID today are part of a new generation that has grown up accessing online content. This younger age group are called the iGen generation. People born in the mid-nineties belong to this generation

(Twenge, 2017). They grew up with the iPhone and iPad. These young people with ID are more involved with social media than the previous generation. Borgström, Daneback and Molin (2019) conclude that risk, vulnerability and the need for support are the most prominent issues for this iGen group with ID.

Table 4 Concept matrix identifying main themes

Article	Opportunities	Risk and Vulnerabilities	Sexuality	Identity	Barrier	Support
Buijs <i>et al.</i> (2017)		x				x
Didden <i>et al.</i> (2009)		x				x
Holmes and O’Loughlin (2012)	x	x		x		
Jahoda and Pownall (2014)			x		x	x
Lough, Flynn And Riby (2015)		x				
Löfgren-Mårtenson (2008)	x	x	x			
Löfgren-Mårtenson, Sorbring and Molin (2015)	x	x	x			x
Molin, Sorbring and Löfgren-Mårtenson (2018)	x					x
Salmerón, Gómez and Fajardo (2016)					x	x
Seale (2014)				x		
Sorbring, Molin and Löfgren-Mårtenson (2017)					x	x
Wright (2017)		x				x
Totals	4	7	3	2	3	8

(Source: Borgström, Daneback and Molin, 2019, p. 134)

As regards the challenge of developing methodological approaches in practice and research around cybersafety for PwID, Borgström, Daneback and Molin (2019) recommend

the concept of positive risk-taking. In Denmark and Sweden, from the early 1970s, there was a growing interest in granting PwID their fair and prudent share of risk-taking in their daily living. It was argued by Perske (1972) that denying PwID exposure to normal risks corresponding to their functioning tended to have a deleterious effect on both their sense of human dignity and their personal development. In addition, the reduction of all risk diminishes PwID in the eyes of others. It is shown how appropriate and reasonable risk-taking can and should be worked into the daily living experiences of the PwID. The idea of positive risk taking was explored as being positive when initiated in different facets of life for PwID in order to facilitate development and change one's circumstances (Seale, Nind and Simmons, 2013; Morgan, 2014). As the internet is part and parcel of everyday life for young people with ID and thus comes with new challenges, this also requires new methodological framework avenues to explore. Seale and Chadwick (2017) in the UK also emphasised the gap in conceptual and theoretical approaches for this kind of research. They too proposed that gaps and problems in the research field need to be met by exploring both methodological and conceptual avenues. In particular, they highlight the need for more in-depth qualitative research that includes the PwID themselves. It is noteworthy that all the findings mentioned in this section were sourced in Europe and in the USA. There is a noticeable gap in research in this subject area outside the Western hemisphere.

2.4.1 Support and Education

Martine -Cao *et al.* (2021) conducted a literature review which identified very few studies to adopt tools specifically designed for research participants with ID or those with neurodevelopmental disorders. However, according to Iglesias *et al.* (2019), these scarce tools have yet to be adequately evaluated and validated. Borgström, Daneback and Molin (2019) highlight the recommendations and need for programmes to educate this user groups about internet risks, and especially about cyberbullying. Didden *et al.* (2009) recommend educational programmes for identification, and support for cyberbullying in special education schools. Wright (2017) calls for educational and prevention programmes that include the users themselves. Buijs (2017) states the importance of implementing and evaluating online cybersafety educational resources for young adults with ID. Yet, from this Ph.D study review, there is very little evidence of these recommendations being implemented. Despite the increase in the use of digital technology by people with

intellectual disabilities in recent years, especially since the pandemic, little empirical evidence considered digital risks and their management (Chadwick et al., 2022). There are few studies focussing on how online harms affected people with intellectual disabilities and those providing them with support during and since the COVID-19 pandemic. Instead, security concerns were only identified as a barrier to digital inclusion (Power et al., 2021; Rawling et al., 2021). This is a considerable oversight considering the increasing sophistication and prevalence of cybercrime. There are many papers calling for educational initiatives but, interestingly, there were few ideas on how they should be developed or implemented. Resources created so far seem to be very linear using old media. Shared decision-making between PwID and stakeholders and positive management of risks are the two important Issues highlighted (Löfgren-Mårtenson, Molin and Sorbring, 2018) and adopting this approach involves a dialectic or communications approach.

2.5 Instructional Assistive Technology as a Gateway

This section will explore instructional assistive technology as a gateway to promote more equality and inclusion for PwID as well as studies highlighting the benefits of instructional technologies. As this research study is adopting a user-centred designed methodology, this literature review will conclude with an exploration of the terminology around this approach to user interface and interaction design.

2.5.1 Background

Assistive Technology (AT) can be defined as “any product, instrument, equipment, or technology adapted or specially designed for improving functioning of a disabled person” (Cook and Polgar, 2014, p1). The emphasis in the early years of assistive technology was on assistive devices, but the focus in this thesis is on assistive instructional technology. Assistive Technology (AT) can be traced back to 1824 when Louis Braille, who was blinded at the age of three, invented the Braille system in 1824 while a student at the Institution Nationale des Jeunes Aveugles (National Institute for Blind Children), Paris. Braille is an assistive technology which allows blind or visually impaired people to do common tasks such as writing, browsing the Internet. Three quarters of a century later, in 1900, the first device to

help people with hearing difficulties was invented (Blackhurst and Edyburn, 2000). The first journal article specifically focused on assistive technology as we understand it today (i.e., technologies designed to support individuals with disabilities) is difficult to pinpoint exactly, because the field evolved gradually and was often intertwined with rehabilitation, biomedical engineering, and special education. One of the first journals containing an article on AT was by RESNA (Rehabilitation Engineering and Assistive Technology Society of North America) in 1979 and the first textbook was entitled *Assistive Technologies: Principles and Practice*, written by Cook and Hussey in 1995. However, it wasn't until the end of the 20th century that collecting data on how AT could benefit education began to be taken seriously for research funding and devices range from an as simple as a pencil grip to sophisticated speech generating devices (Satterfield, 2016). Tools for collecting data in relation to the effectiveness for AT are lacking validation (Borgnis, Desideri, Converti et al, 2023). These researchers completed a comprehensive review of 50 AT outcome studies and 53 instruments and found poor standardisation with only 17 tools designed specifically for assistive devices, many of which were applied only once, severely limiting the ability to compare results across studies. Reviews in both general AT and assistive robotics consistently show:

- Widespread reliance on non-validated, one-off instruments
- Low use of standardised outcome tools
- Pervasive lack of reliability and validity testing
- Difficulty in synthesising or comparing findings across studies

These issues directly contribute to compromised reliability, comparability, and generalisability of evaluation outcomes. Yet, this information is very important for educators, support workers, families, software manufacturers and researchers. There has also been a dispute about exactly what data to collect (Parette, Peterson-Karlan, Smith *et al.*, 2006). For investment purposes and budgeting, research into how successful AT is vital (Satterfield and Smith, 2015). Another challenge in this type of research is the wide range of disabilities in the population. DeRuyter (1998) suggested that AT should be designed for a specific person and focus on improving that person's quality of life. Early studies did not use goals or results: a simple satisfaction survey was completed, and the main focus was on

abandonment of the device (Watson et al., 2010). Abandonment of the device or software is often due to the lack of a user-centred design methodology in its development and highlights the need for the adoption of this approach in the design of all such technology. An approach that is centred on the user helps to improve accessibility and usability for people with ID. This is one of the reasons why this research study *CyberSafe* is employing a user-centred design methodology.

2.5.2 Benefits and Barriers

Focusing now on instructional technology as a type of assistive technology, Ramdoss *et al.* (2012) found people with ID improved in the areas of using public transport, ordering and shopping for food, when taught life skills through computers. iPad software used video prompts and visual clues to teach shopping skills to people with ID. The software was found to be effective and the effectiveness of shopping skills continued when the software was removed (Burckley, Tincani and Guld Fisher, 2015). Stigma can be reduced for users with ID and being seen in public using these devices helps with inclusion in society (Van der Meer et al., 2011). A 2012 systematic review of research between 1990 and 2012 on self-stigma in people with intellectual disability included 37 papers (Ali et al., 2012). The review found that individuals and family carers experience stigma that may negatively influence their psychological wellbeing. Awareness of stigma depends on the extent to which persons with intellectual disability or their carers accept and internalise the label of intellectual disability. Recent developments have focused on using mobile technology to assist PwID with independent travel, organisation and planning (Deklever *et al.*, 2015), and social networking (Daems *et al.*, 2016). Similarly, in another study, the iPad was found to be very effective in prompting participants to carry out simple office tasks such as photocopying and scanning even when the device was taken away (Collins *et al.*, 2014). Researchers found an adult with intellectual disabilities became more independent in the workplace with the help of an iPad in tasks such as creating a highly efficient workstation, time management and the identification of names and faces among other staff (Jones and Bucholz, 2014).

The advantages listed above highlight the importance of instructional AT for people with ID: however, there are also disadvantages. Until a person is comfortable with a device, monitoring may be necessary by an instructor or family member. People with ID may need

help charging or replacing a battery in the device. People with ID have a reduced cognitive ability, making the design of technology for this group more important (Brereton *et al.*, 2015). Even with results showing how well technology can improve the lives of users with ID, as illustrated earlier, this population is still at risk of being left behind as part of the digital divide (Chadwick and Wesson, 2016).

2.5.3 eLearning and ID

eLearning is learning facilitated with technology, which delivers instruction using a web-based medium, for the learner to access remotely (Singh and Thurman, 2019). It is a learner-centered, technology-enabled process of acquiring knowledge and skills through digital platforms, which supports flexible, self-paced, and interactive learning experiences beyond traditional classroom boundaries. In an eLearning platform, the learner uses the internet to navigate through learning materials. eLearning allows the learner to practise at their own pace with adequate support (Standen, Brown and Cromby, 2001). Designing an eLearning application for people with ID needs to consider the learner's specific abilities and context. This makes it a complex process. Learning theories guide the design of usable learning environments. eLearning applications need to be developed based on learning theories. In educational discussions on learning and development, there are three fundamental theoretical frameworks that keep emerging: behaviorism, cognitivism, and constructivism, each of which have been applied, with varying degrees of success, in online environments (Johnson, 2010).

Behaviourism, as the term implies, focuses on observable behaviour and positive reinforcement (Schunk, 1996). Behaviourism is a theory of learning focusing on observable behaviours and discounting any mental activity. Learning is defined simply as the acquisition of new behaviour. B.F. Skinner is widely regarded as a central figure in the development of behaviourism. Skinner introduced the concept of operant conditioning i.e., a learning process through which behaviour is shaped by reinforcement or punishment (Skinner, 1938). His research demonstrated how environmental consequences could systematically influence the likelihood of behavioural responses, leading to practical applications in education, therapy, and behavioural modification programs (Skinner, 1954). From a learning

perspective, content is broken down into manageable tasks that can be practiced until mastery is achieved. Such a theoretical framework has been applied to early teaching practices such as using distinctive units, small steps, simultaneous corrective feedback, and lots of practice (Burton, Moore and Magliaro, 2004). The most common criticisms of behavioural approaches to instruction include lack of meaningful learning and student boredom associated with repeated drill and practice as Malikowski and colleagues (2007, p.155) concluded when they stated that “behaviorism is best suited for tasks that require low cognitive processing and learners with low levels of task knowledge”, which is applicable to this research study’s user group of young adults with ID.

Developed by Albert Bandura, Social Cognitive Theory focuses on interactions of behavioural and personal factors with social settings. Hence, cognitive theory describes learning as an internal process in which the learner uses his memory, thinking reflection, abstraction and metacognition skills (Snowman and Biehler, 2006). Bandura described learning behaviour as an interaction among these three factors: personal characteristics, behavioural patterns and social environment (Bandura, 1986). Personal characteristics relate to beliefs about the ability to carry out learning tasks. Hence, clear goals and reduced anxiety support a better learning experience. Considering the learners’ working memory capacity, subject content should be presented in appropriate amounts, and in sequence. Learning tasks should not overload the learners’ working memory (Anderson, 2008). The learner must be supported to make memory links between new experiences and some related information from long-term memory. Hence, designs for eLearning should accommodate functions with familiar examples that increase the learners’ ability to complete given tasks. Online learning designs should include information in small amounts, and provide opportunity to link new knowledge with existing knowledge

The early constructivist learning theory or concept developed in 1916 by John Dewey implies that students will learn more efficiently in a ‘real situation’ and can improve better through realistic tasks. eLearning applications allow for an array of different learning experiences in contrast to what individuals may learn within a classroom. Constructivism also describes the nature of learning; how people develop as meaningful learners. It involves the learner’s process of understanding how to perform a task according to a

previous experience. According to Schunk (1996), constructivist learning environments are designed for meaningful learning. Different theorists describe different aspects relevant to teaching and learning situations. One single theory cannot address everything to be considered in a particular educational setting. It is recommended to use a blend of theories to address a learning situation, selecting the principles that are relevant and integrating them with eLearning design guidelines. Since the pandemic, there has been an increase in scholarly attention toward online instructional technology. Despite this, there is a significant lack of empirical research with users with intellectual disability. There is a gap in research which explains systematically how and why these technologies improve or impair user performance for users with intellectual disability. Learners with ID have not been included in most of the research for eLearning designs presently available. Web accessibility aims to ensure that people with disabilities can perceive, understand, navigate, and interact with the web. Learning theories outlined earlier have suggestions on designing learning materials, considering the learner situation.

Arachchi, Sitbon and Zhang (2017) carried out a case study to investigate how to apply learning theories along with usability methods when designing educational applications for people with ID. These researchers designed a module about accessing health information, which aimed to improve the internet skills of the users. Images were found to be important when literacy skills were low. Usability of technology was found to be as important as the teaching content. Twenty participants with ID aged between 19 and 46 participated in the research. Four activities were carried out on computers: painting, puzzles, games and web search. These researchers stated that the main purpose of designing eLearning content for people with ID should be to minimise the cognitive load on and capacity required by the learner to interact with the application and the content in order to maximise the cognitive resources available for the learning process. They concluded that the design of the eLearning application for PwID should focus on clearly defined learning tasks as well as the usability of the instructional interfaces.

This research by Arachchi, Sitbon and Zhang in (2017) highlights that it is important to consider existing usability guidelines and learning theories together, in order to increase the accessibility, usability, and pedagogical values of eLearning materials, and offer the learner a learning environment that motivates them to learn. The eLearning materials

should be usable and accessible to them. A recent review of the literature has determined that instructional technologies have predominantly positive effects on the various skills of individuals diagnosed with both ID and autism (Kalemkuş, 2024). The use of instructional technologies in research has been found to have a predominantly positive effect on the education of individuals with ID. This is similar to the findings of other research conducted (Arslan *et al.*, 2022).

2.5.4 Intellectual Disability and Learning Modalities

Learning modalities are ways in which material is presented for the learner. There are many different ways of doing this such as text, audio and video. Games are a popular tool in educational training for learners with ID (Tsikinas, Xinogalos and Satratzemi, 2016). Individuals will have preferred methods of learning influenced by factors such as cognitive ability, environment, and their experiences (Winebrenner, 2016). Using the learning method that suits the individual can help improve behaviour, achievement and motivation (Winebrenner, 2016). This highlights the importance of using a learning modality that suits the cognitive ability of the individual user (Graf and Kinshuk, 2008).

As stated earlier, learning modality refers to how information is presented, and usually includes - auditory, visual, kinaesthetic and tactile presentations. Games are increasingly being used as a modality for educational instruction for PWID (Buzzi *et al.*, 2016, Kwon and Lee, 2016). It is believed that PWID benefit from the visual modality when it comes to memory and comprehension. Game environments can offer resources for empowerment, motivation, and learning (Kwon and Lee, 2016). It has been demonstrated that games with varying ability levels can support this group's engagement and learning (Ke and Abras, 2013). It is clear that for successful training to take place, individuals need to practice regularly, therefore the game must interest the user to engage with the application (Kwon and Lee, 2016). These findings are reflected in previous studies in this area which noted that individuals with ID demonstrated more motivational behaviour with games-based modalities, and that audio was rarely used (Williams, 2015). Therefore, the data indicates that adults with ID demonstrate more engagement-related behaviours when interacting with the games-based content, which is supported by the literature (Brown *et*

al., 2013). A study of serious games for users with ID found that participants liked illustrated graphics in game environments (Lányi *et al.*, 2012). Symmetry and layout complexity are also important aesthetic considerations (Seckler *et al.*, 2015), as is the “cool factor” (Foley and Ferri, 2012, p.198).

The learning-modality needed, relies on the individuals’ learning style which usually differs for everyone depending on a combination of their cognitive ability, their sociological and psychological experiences, and the environment surrounding learning (Ke and Abras, 2013). Literature supports that teaching learners through learning-modalities that match their learning style can lead to an increase in motivation, academic achievement and decrease in challenging behaviours (Winebrenner, 2016). Therefore, providing learning-modalities in relation to cognitive ability and preferred learning-styles is important when it comes to ensuring engaging learning-environments.

One way to design engaging applications, is by taking into consideration the users’ interests and preferences – while controlling for usability, as poor usability can indicate poor engagement (Moshfeghi *et al.*, 2013). Interest/preferences are concepts related to engagement – they function by motivating interaction/attention and engagement; thereby keeping the individuals’ attention focused on the task i.e., intrinsically motivated. Including user interests/preferences, positively impacts the users’ engagement levels. Researchers found literacy skills caused problems for the participants with ID and suggested images and voice over to overcome this issue (Rocha *et al.*, 2015).

None of these studies completely focused on investigating the preferences or interests of adults with ID, in terms of contents within educational applications. In terms of learning-modality preferences, Williams (2015), investigated the website preferences of adults with ID, and found that although audio was appreciated, it was rarely used. Additionally, Brown *et al.* (2013), found that the ‘playful’, gamified mode of their learning application for users with ID, resulted in increased fun and motivation compared to the non-gamified modes. For successful training to take place, the application needed to interest the user to engage with the application (Kwon and Lee, 2016). Moloney (2012) found that PwID preferred to watch videos rather than listen to or read information. This finding was backed up by research by Kagohara *et al.* (2013), that instructional videos support the education of individuals with special needs

Prior to commencing this Ph.D., I carried out a study at the Institute of Art Design and Technology (IADT) which investigated the learning preferences of users with ID in an online instructional context (McDonnell, Connolly and Abbes, 2018). The aim of this earlier study was to investigate the e-learning content (learning-modalities) preferences of adults with ID, and whether their preferences can inform the design of engaging educational content. Mixed methods were used to investigate learning-modality preferences, overall technology experience and opinions of an educational application called “*Let’s Go*”, of seven adults with ID. Results indicated a significant preference for the game-based learning-modality, compared to audio, and video. This is in keeping with research findings elsewhere that indicates that adults with ID demonstrate more engagement-related behaviours when interacting with the games-based content (Brown *et al.*, 2013). In relation to self-reported learning-modality preferences, there was no statistically significant difference between the game, audio, or video-based learning modalities.

Designing without users’ needs in mind can lead to the application not being used for what it was intended. A route learning application called ‘Route Mate’, designed specifically to help PwID navigate their way, was found to improve retention of information, self-determination and motivation when used as a game compared to use as a route learning instrument, suggesting both desires as well as needs should be considered when designing for people with ID (Brown *et al.*, 2013). Cano, García-Tejedor, and Fernández-Manjón (2015) provide an outline of research available on games for intellectual disabilities by reviewing and classifying 43 studies according to the purpose of the investigation and the learning outcomes associated with them. The aim was to provide guidelines for creating games for users with intellectual disabilities. As the attention span of PwIDs can be short, problems can arise when the sole purpose of an interface is to educate the users on a topic in which they may not be particularly interested. However, studies such as Habgood, Ainsworth and Benford (2005) have found that when users participate in engaging and motivating activities, they subconsciously take in more information through deep learning. They noted that deep learning is more likely to occur when users are engaged in activities that are intrinsically motivating. This is important as attention deficit hyperactivity disorder (ADHD) affects up to 20.4% of adults with intellectual disabilities (Al-Khudairi *et al.*, 2019). Borgström, Daneback, and Molin (2019) reported that over half of internet users with ID

(57%) reported using the internet to play online games. Saridaki and Mourlas (2013) studied the impact of incorporating games into the classroom environment of students with intellectual disabilities. The results concluded that by integrating games in the educational process, students with ID feel more prepared for social integration and practical academic skills.

2.5.5 Intellectual Disability and Interactive videos

The use of video in a learning environment provides students with a flexible learning option and keeps them engaged (Gedera and Zalipour, 2018). Bayor *et al* (2021) found video to be very effective with PwID based on their experience in designing SkillsTube, a web application they co-designed with young PwID to support them to learn life skills through videos. Video has also shown to be just as good, if not better than face-to-face learning (Smith and Francis, 2022). This is due to students having control over their own cognitive load through the device's affordance capabilities i.e., the pause or rewind functions. The ability of students to manage their cognitive load through features such as pause and rewind functions can be understood through the lens of affordance theory, originally developed by Gibson (1979) and later adapted to technology by scholars such as Norman (1988). In this context, an *affordance* refers to the perceived and actual properties of a technological tool that determine how it can be used. For PwID students, the ability to control pacing, by pausing or replaying content, constitutes a critical affordance that supports cognitive regulation and personalised learning. These features allow learners to process information at their own speed, revisit challenging content, and reduce cognitive overload (Sweller, 1994), which is especially beneficial in digital learning environments. Importantly, these affordances do not simply reside in the technology itself but emerge through the interaction between the learner and the device (Conole and Dyke, 2004). Thus, when educational technologies provide such user-controlled functionalities, they enable learners to actively engage with content in ways that align with their individual processing needs, supporting both accessibility and deeper learning. The student's ability to learn at their own pace, along with teachers being able to edit videos to make their teaching more coherent and clearer is the reason why video is an effective format for learning (Noetel *et al.*, 2021). From a multimedia learning perspective, video combines visual, auditory, and

textual cues, which can reduce cognitive load and support meaning-making when designed effectively (Mayer, 2009; Mayer and Fiorella, 2014). Importantly, the ability for teachers to edit and adapt video content positions them as prosumers who actively participate in the encoding process, shaping narrative structure, emphasis, and framing to align with specific learner contexts (Jenkins, 2006; Bruns, 2008). This participatory approach enhances communicative coherence by allowing educators to clarify meanings, foreground key messages, and remove ambiguity. This capacity to intervene in the encoding process draws on Hall's (1980) encoding/decoding model, challenging one-size-fits-all educational media. Video operates not simply as a transmission medium, but as a participatory communicative practice in which meaning is collaboratively constructed between producers and audiences through iterative design and engagement (Freire, 1970; Kress, 2010).

Interactive videos are a form of media that allows for viewer interaction, allowing viewers to navigate through several narrative options. They improve engagement by increasing viewers' attention span and interest in the content by providing an immersive experience (Upadhyay, 2024). Storytelling is used across many disciplines, with narrative methods and technologies (such as digital storytelling) helping to boost learners' engagement and understanding (Hall, 2022). Interactive storytelling involves telling a tale that has not been resolved. In contrast to traditional storytelling, this approach gives the audience a variety of possible outcomes based on their decisions. As a result, they become active participants rather than merely passive viewers or listeners to the story.

Interactive videos have several different applications such as entertainment, learning and marketing. Interactive videos have evolved exponentially through the years and are now commonly used in games and other forms of media. They have been present in media for decades, with many attempts of incorporating interactive elements in films and video games emerging in the 1960's (Murray, 2017). Interactive videos could be the solution for fostering interactive learning while also guaranteeing learner satisfaction and success (Desai and Kulkarni, 2022). Interactivity in videos gives students a sense of control and empowers them to be in charge of their own learning (Gedera and Zalipour, 2018). As Universal Design for Learners gains more importance with the improvement of accessibility for students with ID, interactive videos could become a useful format to use as instructional guides for a wide

range of learners, including those with disabilities (Rao et al., 2021). There has been very limited research to on the use or effectiveness of interactive videos on young adults with ID. Barman and Jena (2023) assessed interactive video-based instruction (IVBI) on 95 adolescents with ID (males = 47 & females = 48) with an age range between 12 and 15 years). All participants had moderate intellectual disability and were recruited in India from three day-care rehabilitation centres. The main objective was to examine the effect of IVBI intervention on academic performance and findings conclude that children in the IVBI group performed more actively as compared to the comparison group. This was due to the involvement of video-based instruction that helped understand the topic more precisely.

As interactive video becomes incorporated into e-learning content, it's effectiveness in a learning environment needs to be researched further. Desai and Kulkarni's (2022) study concluded that students achieved higher learning outcomes and had a higher learning satisfaction if interactive videos were a part of their education. The University of Central Lancashire use interactive videos to teach their medical students. Students are split into groups and then given a brief on how to use the interactive video. The students must work together to treat the patient in a timely manner. This is an effective way of incorporating interactive video and gamification into an educational setting. This simulation received an extremely positive response with 97% of the students agreeing that it challenged their thinking and they would recommend it to other students (Colthup and Ross, 2024). None of these studies completely focused on investigating the use of interactive video with adults with ID, in terms of content within educational applications.

2.6. User centered design

User centered design was first defined by Norman (1988, p.188) as "a philosophy based on the needs and interests of the user, with an emphasis on making products usable and understandable". User-centred Design (UCD) sees users and their goals as the accelerating force behind product development and is achieved by involving users in the design and/or evaluation process (Sharp *et al.*, 2019). This approach describes a design process that involves the potential user at all stages: requirements, prototyping, testing and evaluation (Preece, Rogers and Sharp, 2015). User-Centred Design (UCD) is an iterative design approach promoting the active involvement of users in the process of design to

improve the understanding of their needs and requirements (Mao *et al.*, 2005). Since then, UCD has been applied in various manners and contexts, while keeping engagement of users as a central aspect. A standardised framework for human-centred design was created (and is regularly updated) by the International Organisation for Standardisation (ISO), incorporating the following principles:

- the design is based upon an explicit, understanding of users, tasks and environments;
- users are involved throughout design and development;
- the design is driven and refined by user-centred evaluation;
- the process is iterative;
- the design addresses the whole user experience;
- the design team includes multidisciplinary skills and perspectives (International Organization for Standardisation (ISO), 2022).

Hassenzahl and Tractinsky (2006, p.91) highlighted that 'user experience' (UX) has become fashionable in the field of human - computer interaction (HCI) and interaction design. They keenly observed that 'the term promised change and a fresh look, without being too specific about its definite meaning'. Many authors discuss the central role it plays, and the obstacles to improving the user experience without ever actually defining it (Finstad, 2006). Fortunately, Norman and Nielsen, the grandfathers of UX, clear up the confusion with a clear definition which states that "User experience encompasses all aspects of the end-user's interaction with the company, its services, and its products" (NNgroup, 2021). The emphasis here is on the value the product adds to the user and the business. Consequently, user experience is much bigger in a business sense than the user-centred design process or methodology. The definition of UX by Sward and McAuthor (2007, p.38) demonstrates "it's relationship with UCD, a philosophy that places the user at the centre of all design activities. UX extends UCD to incorporate all aspects of the end user's interaction with the product or service and the organization that supports it".

This definition emphasises the worth derived from all of the customer's interaction(s) and communications with a business product or service and the supporting business services that help the customer (e.g., marketing, customer support). This term

“value” can mean actual worth to the user or customer (e.g., is the product efficient and effective), or what the user perceives as value (asking questions like e.g., is the product trustworthy, emotionally satisfying, visual appealing, socially motivating and entertaining etc.), or a combination of both.

User-centred Design is distinct from Design-Based Research (DBR), which is a research methodology widely used in the learning sciences and educational research. DBR emphasises designing interventions (i.e., learning environments, tools or pedagogical approaches) that address real challenges in educational settings. It does this by iteratively implementing, evaluating, refining and re-testing those interventions and generating both practical improvements and theoretical insights into how learning occurs (McKenney and Reeves, 2018). DBR helps to bridge the gap between theory and practice by developing interventions that are tested in applied educational contexts and accommodate change through reflexive, iterative changes (Flynn *et al.*, 2022). Design-Based Research (DBR) and User-Centred Design (UCD) overlap in some ways but come from different traditions and aim at different outcomes. Design-Based Research (DBR) aims to both improve practice in real educational contexts and develop theory about how learning works (Reeves 2015). User-Centred Design (UCD), on the other hand, originated in Human–Computer Interaction (HCI), ergonomics and product design and its purpose is to ensure technologies, tools or services are usable, effective, and satisfying for their intended users (Chun, Harty and Schweber, 2015). DBR uses iterative design, implementation and evaluation cycles in authentic educational settings and is interventionist as it creates and tests new pedagogical strategies, digital tools or curricula. UCD also focuses on iterative prototyping and testing with end-users but in laboratory settings throughout the design process and its methods emphasise interviews, personas, empathy mapping and usability testing. UCD focusses on producing usable artefacts, not necessarily theory. It could be argued that both approaches can complement each other: UCD can feed into DBR as a design methodology, while DBR can provide a broader educational research framework.

A structured comparison of DBR and UCD is provided in Figure 5.

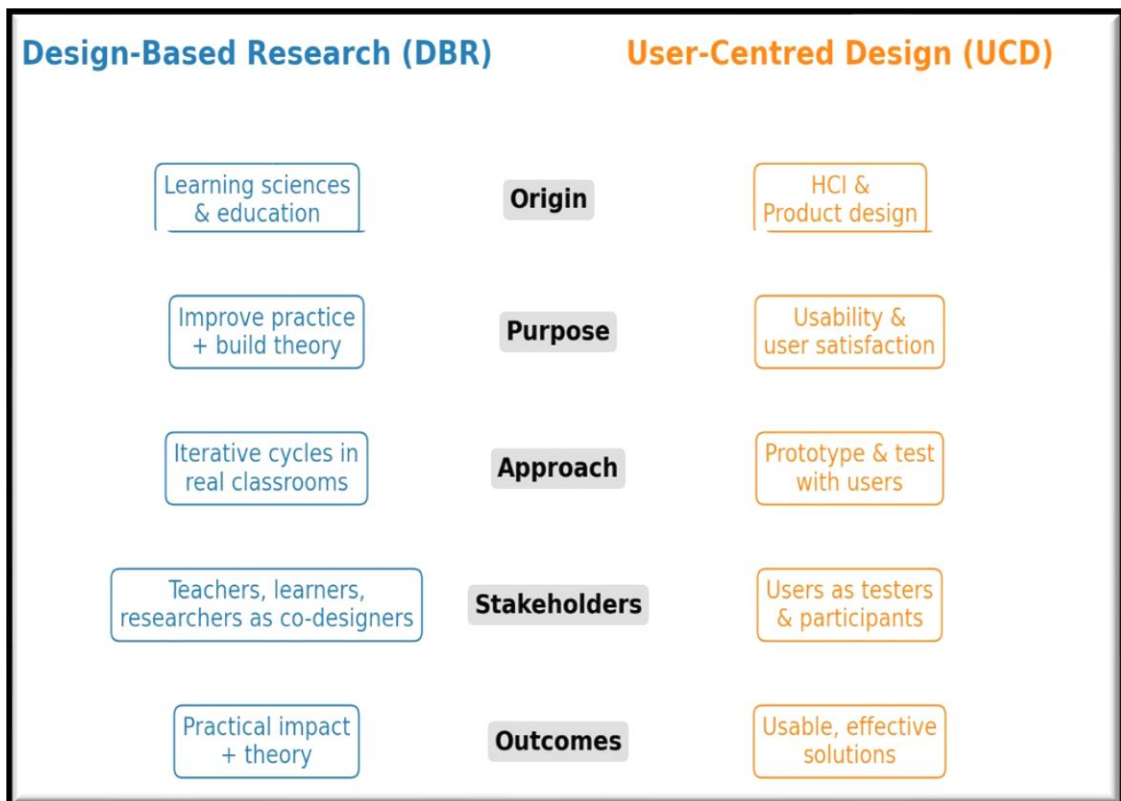


Figure 5 Structured comparison of DBR and UCD

Chun, Harty and Schweber (2015) describe four, supposedly distinct approaches, which currently dominate UCD in the context of research. These include: Participatory Design, Co-Design, Space Syntax and Usability of Buildings. The first two of these terms are applied to software systems and are relevant to this thesis. Space syntax provides an objective method for representing the continuous spatial layout of a building, in relation to the way it is used. The aim is to find out why certain spatial layouts work for users and others do not (suburban 1970's social housing estate versus traditional houses in the city). Usability of Buildings focuses on the relationship between buildings and people or groups of people. The aim was to identify methods and tools that could provide a better understanding of people's user experience of buildings to promote a more positive user experience in organisational settings (Jenso, Hansen and Haugen, 2004).

Although Space Syntax and Usability of Buildings traditionally focus on the spatial and functional qualities of physical architecture rather than digital user interfaces, both can be meaningfully interpreted through the lens of affordance theory. Space Syntax effectively

shapes what behaviours are possible or likely within a given environment. In this way, spatial arrangements afford or constrain specific forms of human activity, echoing Gibson's (1979) notion of affordances as action possibilities offered by the environment. Similarly, the usability of buildings closely aligned with Norman's (1988) interpretation of affordances as the perceived and actual properties that suggest how something can be used. Therefore, both frameworks, while grounded in architectural design, align with the affordance perspective by examining how the built environment communicates and enables functional and meaningful user interactions. This conceptual linkage expands the scope of affordance theory beyond digital systems, highlighting its relevance in understanding human-environment relationships in both physical and virtual contexts. Space Syntax and Usability of Buildings are approaches, which though currently topical in UCD in the context of research, are not relevant to this thesis as they deal with buildings not user interfaces.

2.6.1 Participatory Design

Prior to the emergence of participatory design, researchers within the field of human-computer interaction explored methodologies to support the design of hardware and software (Francis, Balbo and Firth, 2009). User participation in system development originated in Scandinavia in the 1970s and was known as participatory design (Halskov and Hansen, 2015; Spinuzzi, 2005). Participatory design (PD) studies emerged within the designing and development of information-communication technologies (ICT), specifically through a partnership between academics and trade unions (Bødker, 1996; Sanders, Brandt and Binder, 2010; Spinuzzi, 2005). This collaborative strategy towards design allowed for workers to influence and improve the design of ICT in the workplace (Sanders and Stappers, 2008). Participatory approaches and practices within design can improve mutual learning and understanding, integrate the ideas of different people, and enhance communication and cooperation between individuals as well as initiate joint creation of new ideas (Muller and Druin, 2012). Since its emergence, participatory design has become a widely accepted methodology in the fields of design and human-computer interaction (Yoo *et al.*, 2013). Furthermore, collaborative approaches towards design are, today, applied across a broad spectrum of domains such as space design, product development, industrial design and architecture (Sanders *et al.*, 2010).

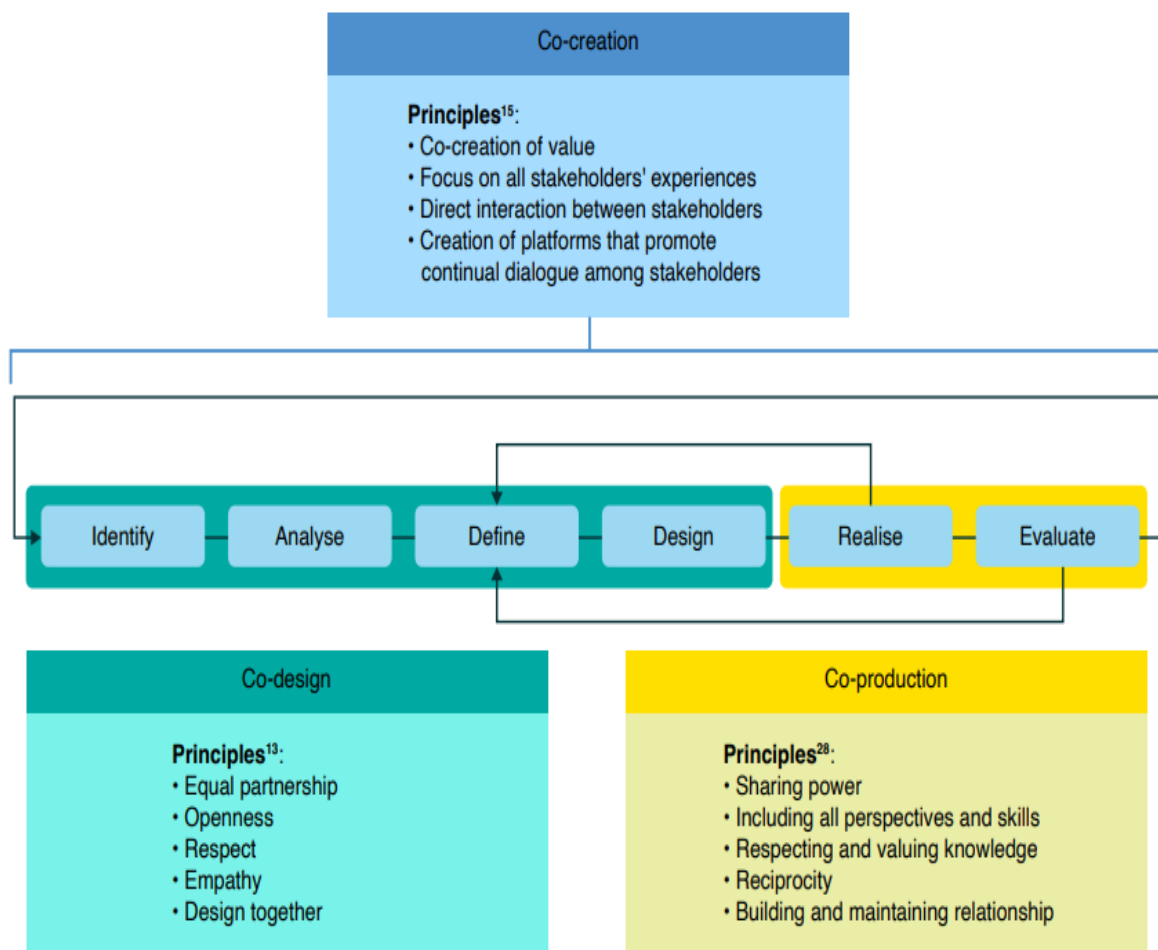
2.6.2 The Co-Design Approach

From within the field of participatory design, the concepts of co-creation and co-design have developed (Sanders and Stappers, 2008). The attention paid to co-design has grown exponentially in recent years (Steen *et al.*, 2011). Co-design, 'cooperative design', emerged in the late 1990s building on the Scandinavian participatory design techniques (Yoo *et al.*, 2013). This approach to design involves the creative collaboration of diverse experts - researchers, designers or developers - and the end-users, untrained in design, throughout the design and development process (Dodero *et al.*, 2014; Steen, Manschot and De Koning, 2011). End-users are considered the experts on their lives and hold unique expertise in design, a crucial component of design (Rajapakse *et al.*, 2015). While members of a co-design team are equally involved in the process, they each hold a diverse role. Researchers facilitate the process, designers contribute their expertise, and end-users become co-designers (Dodero *et al.*, 2014). This collaborative design approach engages potential end-users and stakeholders in order to develop designs which meet the needs of such individuals (Reay *et al.*, 2016). Co-design seeks to enable the future users of the technology to have a voice in its design (Robertson and Simonsen, 2013; Wilson *et al.*, 2015). User participation in the design process has the potential to enhance technology design which can, subsequently, improve the lives of many people (Vines *et al.*, 2013). The evolution of participatory design and co-design have created the basis of inclusive practices where equal participation and shared creativity are in the centre. Co-design entails the active engagement of target users and stakeholders in the previously top-down, expert driven process of design (Bayor *et al.*, 2021; González *et al.*, 2020). PD is often used as the synonym of co-design in the literature. However, participatory design is an umbrella term under which co-design is situated. The main difference is while PD refers to the full spectrum of activities, from ideation to the completed solution (Whittle, 2014), co-design is defined as a collective creativity applied throughout the design phase of the creation process (González *et al.*, 2020). In both methods, the historic power imbalance between stakeholders shifts to a collective, equal ownership (Donetto *et al.*, 2015).

Masterson *et al.* (2022) discussed the confusing and ambiguous use of “co-words” which Williams (2015) terms the “cobiquity”. These “co-words”, such as co-creation, co-production and co-design carry different meanings from varied collaborative traditions. According to Sanders and Stappers (2008), co-creation is an act of a collective, creative

process that is shared by two or more people, whereas co-design is a less generic term as it only applies to the design phase of the creation process. To reduce ambiguity, the common ground for these terms is the creative practice that involves the end-users and various stakeholders in contributing to finding a solution for a problem. The distinctions between the terms could be the phase of the process, the range of co-creation activities the participants engage in, and their function within the process. The participants can take part either in all stages, including ideation and development, or just specific ones. Vargas *et al.*'s (2022) research supports Sanders and Stappers' (2008) perspective on the differentiation between the three design methods. They define co-creation as a creative problem-solving method including different stakeholders. Both papers agree that co-creation is the broadest term, encompassing collaboration at all stages of a study, from problem identification to evaluation. realise and evaluate.

Figure 6 A Stages of co-creation divided into co-design stages and co-production stages (Source: Vargas *et al.*, 2022).



Co-creation contains six stages of collaboration: identify, analyse, define, design, realise and evaluate. The first four stages are within co-design, and co-production contains the last two stages. In essence, co-design develops the plan, and co-production executes the plan. These two concepts are not mutually exclusive approaches but connected stages of one collaborative process during which the stakeholders are on equal footing, working together for a common goal with respect and empathy. In more recent years, the most frequent use of Co-Design for accessibility purposes has been in a healthcare setting, aiming to improve the quality of patients' experience and care by including them in the process of designing the equipment they will be using (Slattery *et al.*, 2020).

2.6.3 Design for Users with Intellectual Disability

User-centred design is the recommended approach when designing for users with intellectual disability (Miesengberger *et al.*, 2020). This approach encourages designers to place the needs, wants and desires of these users at the centre of the design process. This technique allows these elements to drive the development process (Dorrington *et al.*, 2016). Researchers employing the co-design approach recognise the benefits of involving users earlier in the process. In this approach, the users are involved during the design process in addition to the user testing during which the users determine the usability of the product by target users (Ladner, 2015).

Inclusive design practices are evolving towards co-design approaches that engage users with intellectual disability throughout the development and design process (Sitbon and Farhin, 2017). This approach overcomes the issues of overlooking individuals in this population and designing based on an understanding of what is needed. Collaborative approaches to design allow for the improvement of existing technologies and the developing of ICT more sensitive to the needs and desires of specific user groups (Vines *et al.*, 2013). Co-design approaches provide individuals in this user group with the opportunity to have an input into how technology can best support them and their individual needs (Sitbon and Farhin, 2017). The involvement of people within this population during the development and design process is both empowering for the individuals as well as important for achieving the most usable designs (Ladner, 2015). While much of the literature describing co-design involves the

participation of groups often excluded, there is limited co-design research involving PwID. When individuals have a different cognitive and sensory experience of the world, their engagement in the design process of technologies designed for them is of particular importance (Brereton *et al.*, 2015). The involvement of such individuals during the design of technologies aids the development of ICT, which is accessible and usable by the target user group. It is suggested, in the literature within design for PwID, that some of the best work is as a result of contributions from this population to aspects of the design and development processes (Ladner, 2015). Co-Design is a promising method for improving accessibility to products (Woodward *et al.*, 2023), by giving people, especially vulnerable populations, a voice to express their wants and needs in relation to the design of the products they use.

2.6.3.1 Co-Design Techniques Involving Individuals with Intellectual Disability

The direct involvement of individuals within this population in research studies can be problematic due to communication and cognitive difficulties. However, such difficulties can be overcome through management and adaptation of the co-design process (Francis *et al.*, 2009). Bircanin *et al.* (2021) states that the application and research of co-design for persons with PwID is still very sparse, but more recently there has been a rise in the research and application of co-design for persons with ID (Bircanin *et al.*, 2021, 2025; Woodward *et al.*, 2023). Co-design processes involving PwID may require some modification of techniques in order to develop a suitable method for this population. Sitbon and Farhin (2017) recommended four ingredients in order to deepen the engagement of participants: a digital prototype, a non-finito feature (unfinished feature which engages the participants to design what they want), inclusion of a proxy, and a co-development opportunity. Proxies are people in PwID close networks who are familiar with, and can speak for and about, the individual such as family, friends, teachers, support workers and healthcare professionals (Brereton *et al.*, 2015; Wilson *et al.*, 2016). Involving proxies during the development and design process of applications is recognised as a method of designing with individuals with intellectual disability. They observed three users with intellectual disability engaging in an hour-long co-design workshop with a support worker, designing a mobile application to support people with intellectual disability when using public transport. This observation confirmed the benefits of digital prototypes and non-finito features in this context. They identified the need for a better understanding of the role of proxies and suggest a longer

engagement time with the users to potentially take advantage of co-development. However, it is important to note that there is conflicting literature in relation to the importance of engaging proxies, who sometimes can speak on behalf of the individual with impairments, in the design process. Some researchers draw attention to the risks of heavily and uncritically relying on the input of proxies. Contrastingly, other researchers highlight the value of their design insights (Sitbon and Farhin, 2017) as PwID can often experience impaired communication skills and it can be difficult for them to communicate their needs. Thus, involving proxies during the development and design process of ICT is recognised as a method of designing with individuals with intellectual disability. Proxies can provide a useful and significant perspective. However, it is important to acknowledge and consider that the individual with intellectual disability may express different views (Brereton *et al.*, 2015).

Given this context, one of the key aims of this *CyberSafe* research study was to explore, adapt, design and extend a methodological approach to the practice of user-centred design for this user group, as proposed by Edler (2020) in an EU project context. Mainstream techniques in user centered design require the user to think in an abstract manner. This task can cause difficulties for people with ID (Dekelver *et al.*, 2015). A clear and tested methodology to develop interfaces for people with ID does not exist. The process is very complicated and is related to the nature of the disability and the way society deals with it. Scheibenz (2005, p. 22) explains some of the reasons for this situation: “There is a wide range of different disabilities and often people have combination of different disabilities; the market for assistive technologies is small; there exists only little experience in testing with disabled people”. The Delgado *et al.* (2019) study, which tested the effectiveness of a programme to improve the ability of young adults with ID to evaluate information on websites, demonstrated that the users showed a level of abstract thinking. However, the authors conclude that, where the average IQ standard score was 50.72 (close to moderate intellectual disability), it was questionable whether students with this IQ are capable of making abstract decisions for evaluating information sources. Research literature to date has demonstrated no methodological approaches to practicing user-centred design for adults with ID (Edler, 2020). The World Wide Web Consortium (W3C, 2020), which is the main international standards organisation for the World Wide Web, have strategies to improve accessibility for these user groups and develop guidance and techniques for

designers and developers (W3C, 2020). W3C have developed initial approaches to and examples of targeted guidelines, methods, techniques and tools to achieve a high level of usability for people with disabilities. But their work also highlights that user-centred design (UCD) is not taken up and widely used in a comprehensive manner due to a lack of understanding of the benefit, lack of skills, knowledge or know-how and support for efficiently facilitating UCD (Meisenberger *et al.*, 2020). The costs of UCD are resource and time intensive and they are not valued against the perceived return on investment. As a result, UCD remains more of a kind aspiration or an extra rather than the main guiding principle of this type of research and development. Edler's research (2020, p.44) gave the following recommendations, learned from the EASY Reading EU Horizon 2020 project, for inclusive participatory research and development:

- Inclusion of the target groups as peer-researchers requires a high degree of willingness and intuition on the part of the researchers and developers;
- The necessary resources like time, material, and also the payment of the peers must be considered;
- The research project must have a high level of accessibility i.e., all information provided in easy and understandable language about the research;
- Peer-researchers are expected to participate voluntarily and to show interest and a certain degree of personal responsibility;
- To meet the ethical requirements for research, informed consent in plain language and/or another format is necessary and at best also confirmed in writing;
- Transparency and traceability require not only the complete documentation of the research process, but also that the peer-researchers are mentioned by name as co-authors and that the results are available to them in is easier to understand language;
- Before the development of the process starts, a formal introduction/training in research skills for people with intellectual disabilities is necessary to enable them to contribute to research.

This user-centred design (UCD) approach allows the needs, wants and desires of these users to inform the development process but is time consuming (Dorrington *et al.*, 2016). Although, user-centred design is not a popular approach when designing for users

with ID, researchers (Ladner, 2015) are beginning to recognise the benefits of having users with ID involved, from the early stage of the design process right through to user testing.

To conclude this section, literature in this field recognises that there is much to be gained from the inclusion of PwID as co-designers within the development and design processes. Once provided with a suitable platform, individuals can share their needs, opinions and goals with confidence (Wilson *et al.*, 2016). While user participation in design has become well-established since its early inception, it is only in more recent years that this approach has been considered for PwID. As this approach to design becomes increasingly popular among designers for PwD, researchers will adapt the existing co-design techniques in order to establish a more appropriate framework suited to the needs and abilities of users in this population.

2.6.4 Design Principles for Interface Design for PwID

Creating user interfaces to fit each PwID's needs is challenging due to the overwhelming variety in disabilities and individual characteristics. There are various guidelines about improving the accessibility of technology interfaces (Friedman and Bryen, 2007) as well as inclusive design frameworks that emphasise the importance of adapting digital platforms to meet the needs of diverse user groups e.g., Universal Design (Goldsmith and Architects, 2000), Design for All (Clarkson *et al.*, 2013), and the World Wide Web Consortiums (W3C) with the Web Content Accessibility Guidelines (WCAG) (W3C, 2023). The term Universal Design (UD) has been attributed to the work of Ronald L. Mace at the North Carolina State University Centre for Universal Design (Kim and Jeong, 2020). Mace defined the term in 1985 as the design of products and environments that are usable by all people without adaptation (Mace *et al.*, 1998). Prior to this definition, the term 'inclusive design' was globally recognised, while the Council for Europe and the European Commission favoured 'Design for all' (Dolph, 2021). Despite the variation in terminology, the concept of UD has had the greatest success in the United States (Lee and Xie, 2024).

Although Mace was an architect, he understood that the idea of UD needed to focus on much more than just architectural space and emphasised the importance of designing with accessibility in mind. With the help of ten cross-disciplinary researchers, a set of principles were developed by which UD could be assessed. These principles state that the

design process must favour equitable use, flexibility in use, be simple and intuitive, provide perceptual information, have tolerance for error, require low physical effort and size, and space for approach and use to be considered universally designed (Burgstahler, 2009). Shortly after these principles were established, one of the researchers involved in their creation, Gregg Vanderheiden, suggested that the definition be expanded to include the creation of devices, systems, interfaces and processes (Vanderheiden and Tobias, 2000).

These guidelines and frameworks provide principles for simplifying content, improving navigation, and incorporating multimodal feedback (Chinn, 2019). Specific design elements are addressed, referring to interface features such as navigation structures and text presentation to enhance the accessibility and usability of digital platforms for users with diverse cognitive and literacy needs. Universal design principles aimed at facilitating internet accessibility for PwID recommend using pictures to convey information and repeating this information in text format, simple navigation with few choices, and an emphasis on providing interaction and feedback (Murphy *et al*, 2024). Although a well-known framework, universal design has been criticised for its “one size fits all” approach. Disagreements exist over the use of UD for this user group (McDonnell and Verdes, 2016, p.265). Literature highlights a lack of agreed design principles when developing applications, as "one size does not fit all". Intellectual disability accessibility can call UD into question – as it is not possible to design a product for all especially in the broad area of ID (Bayor *et al.*, 2021). These researchers argue that users are intrinsically different with varying abilities, submitting that designs should reflect individual user needs. They also also argue that if a design can employ competencies, using existing elements of systems and technologies that most people, including those with intellectual disability possess, like YouTube searching skills, then due to their prior engagement or attempted engagement, it will support greater participation. Bayor *et al.* (2021) described what they termed “competencies,” in a long-term co-design study with PwID. These competencies incorporate the representative practical skills people develop from their participation in life activities, in particular, mainstream technologies, such as social media and the Internet. Their reflection is based on their experience in designing SkillsTube, a web application they co-designed with young PwID to support them to learn life skills through videos. Using existing competencies of users is an effective way to achieve universal design’s vision of “design for all”. This involves

exploring and designing with the existing technology capabilities of a variety of users, including PwID e.g., their competence to search for and play videos. This approach is called a competency-based design and it provides an effective avenue for achieving universal design's vision of "design for all," through exploring and designing with the existing representative technology competencies of a variety of users, including PwID.

2.6.4.1 Universal Design and Influence of AI

Digital accessibility is essential in today's technology-driven society. The World Health Organisation states that 16% of the global population, roughly 1.3 billion people, currently suffer from a significant disability either physical, cognitive or both (Chemnad and Othman, 2024). This statistic highlights the importance of utilising UD to ensure that people with disabilities are not excluded from participating in today's digital society. As AI continues to permeate everyday aspects of our lives, it is crucial that these technologies are usable by all individuals, as those living with disabilities have been among the earliest people to adopt interactive AI in their daily routine (Bigham and Carrington, 2018). Artificial Intelligence (AI) is becoming an increasingly prevalent force in education (Ifenthaler et al, 2024). Holmes and Tuomi (2022) define AI as computer systems capable of tasks traditionally requiring human intelligence, such as decision-making, problem-solving, language understanding, and personalised instruction. AI tools now encompass adaptive learning systems, intelligent tutoring, natural language processing, and advanced analytics, dramatically transforming educational landscapes (Jia *et al.*, 2024). Students with cognitive disabilities like PwID often encounter significant barriers within traditional learning environments (Kohnke and Zaugg, 2025). Traditional methods can exacerbate existing challenges related to language acquisition, retention, and fundamental academic skills such as reading and writing. AI technology is emerging as a mechanism for overcoming these barriers. For example, adaptive learning systems employing predictive analytics and personalised diagnostic tools facilitate tailored educational experiences, significantly improving student engagement (Kohnke and Zaugg, 2025). Moreover, intelligent tutoring and mastery learning systems have demonstrated notably higher engagement levels compared to traditional platforms, suggesting their efficacy in delivering pace-appropriate, personalised instruction. Such technological innovations underscore AI's transformative potential as a powerful tool in

addressing educational inequities, fostering inclusive learning environments, and ultimately enhancing academic performance and student engagement across disciplines (Lohakan and Seetao, 2024). The area of AI and accessibility has untapped potential, and arguably we are only at the start of what this technology has to offer for accessibility. There are still huge gaps in research such as researching the use of AI for students with cognitive or developmental disorders to improve engagement and learning. AI-enhanced assistive technology can be a significant factor in the participation of students with cognitive disabilities in mainstream schools (McNicholl *et al.*, 2021). One health study with PwID highlighted the fact that AI learning platforms can be very helpful in enhancing the motivations of persons with ID (Kharbat *et al.*, 2021). Their study found that students who used an AI-powered learning platform were more engaged in their educational activities and more motivated to learn than students who did not use the platform. There is a gap in the current literature regarding using artificial intelligence in supporting the education of PwID. User-centered design approaches are essential for creating AI interfaces that truly meet the needs of PwID (Garcia *et al.*, 2023). By prioritising accessibility in development, stakeholders can foster a more inclusive technological world (Nguyen *et al.*, 2024).

Despite these promising developments, there are potential risks and significant concerns associated with combining AI and Universal Design. Designing interfaces that are both AI-powered and universally accessible pose several challenges, including ethical and privacy concerns. As AI systems make decisions based on datasets and algorithms, the information used to construct them are pivotal. The platforms that the datasets are derived from may lack information from certain communities or groups like PwID, and these knowledge gaps can perpetuate discrimination against excluded groups. It is vital that AI technologies are developed with input from individuals with ID, to reduce the possibility of perpetuating existing biases towards these groups, as well as ensuring that the technology is effective in meeting their needs. These biases are capable of shaping societal structures and influencing decision-making processes, and have the potential to perpetuate unfair treatment and discrimination (Khan, 2024). Esquivel *et al.* (2024) reported that the lack of education and understanding regarding data privacy and AI were two of the main reasons that individuals with cognitive disabilities feel excluded from AI platforms, which can result in further social exclusion. To combat this, regulatory frameworks have been established,

such as the EU's Regulation on Artificial Intelligence, which aim to ensure that AI systems uphold fundamental rights, are non-discriminatory and transparent (Khan, 2024). This will be monitored by ensuring that all AI systems are overseen by humans, not automation, to prevent harmful outcomes (OECD, 2019; UNESCO, 2021). Incorporating a "human-in-the-loop" approach in AI systems is essential to ensure accountability, prevent automation bias, and maintain ethical oversight (National Institute of Standards and Technology, 2022). Where user feedback was actively incorporated into AI system training or interface evolution, the tools were markedly more effective and accepted. This supports the push toward user-in-the-loop AI design as a gold standard for accessibility-focused UX innovation (Kavinda, 2025). Utilising Universal Design principles in the creation of AI systems will ensure that these technologies are developed in an equitable and inclusive manner, allowing the digital world to be leveraged by all.

2.6.4.2 Previous Interface Design studies with PwID

Testing user interfaces with PwID is problematic. Web designers do not usually have an understanding of PwID, they have very little experience testing with this group, the population is small and there are so many different types of ID (Dekelver et al., 2015). Despite the variety of needs and individual differences under the ID umbrella, user research has been conducted, to discover design principles for user interfaces for this population (Buzzi et al., 2016). This research has revealed that animations involving bright colours and motion were liked, especially if personalised. Sound effects with exaggerated and fun like characteristics and incorporating pop music etc. were also favoured. Users preferred clicking the largest button on the page, and were more inclined to click buttons with a dark background accompanied by light text on top. Consequently, buttons with a clear clickable area are advised, having an outline instead of only being underlined for example. Similarly, buttons with arrows pointing towards them worked well. Furthermore, users liked buttons that were very clear in telling the user what to do.

Rus *et al.* (2017) found that PwID preferred a tablet over a smartphone where icons and buttons were too small. This increased button size helps accessibility. A search feature accompanied by an auto-suggest functionality enhanced ease-of-use and speed of task completion. Passwords proved difficult to implement along with confusion of drop-down

menus, likely due to the options being hidden. In a reading and comprehension test on 16 students with mild ID, (Delgado *et al.*, 2014), the researchers found a negative correlation between the number of sentences and the comprehension of the test. Therefore, text should be short and simple using words repetitively where possible.

2.6.5 Dimensions of User Experience: Usability, Engagement and Aesthetics

Usability is defined as “the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use” (ISO 9241-11:1998, p.5). Usability is concerned with the interaction between a user and the product as well as how well the product operates. A product that is usable should be effective, efficient and satisfactory. Effectiveness is measured through goals reached by user, efficiency measures the work load necessary to complete the goals and satisfactory measures how easily the goals are achieved (Deklever *et al.*, 2015). When testing an application, researchers are also interested in how the users engage with it.

Usability is an attribute which assesses how easy an interface is to use (Nielsen, 2012). Three important principles of usability are effectiveness, efficiency and satisfaction which determine ability to achieve goals, effort used in achieving these goals, and ease of use. (Deklever *et al.*, 2015). Traditional usability evaluations collect data about users’ performance on set tasks, task completion time, number of errors and post-test questionnaires (Sharp *et al.*, 2019). Some of these methods are not ideal for PwID (Caliz, Martinez and Caliz, 2016) although other methods, such as use of an interactive prototype can be particularly important for persons with ID in facilitating greater engagement in the process (Sitbon and Farhin, 2017). There is no single accepted method for usability testing involving PwID. USATESTDOWN offers a comprehensive usability testing guide of mobile devices for people with Down syndrome (Caliz *et al.*, 2016). Some of its recommendations include use of accessible documentation including an adapted System Usability Scale (SUS), care around anonymity, and careful framing of questions due to users’ potential unwillingness to give negative feedback owing to their naturally friendly predisposition. Usability is closely related to accessibility, the main feature of which is inclusion of functionality that makes use by PwID possible. Specific mobile

interface design guidelines seek to improve usability and accessibility for PwID by making recommendations around navigation, graphic design, text requirements and personalisation.

Engagement refers to the user being actively involved with the application. Engagement can be further divided into behavioural, affective and cognitive components. (O'Brien and Toms, 2008). Behavioural engagement measures how much time a user spends focusing on a task. Affective engagement measures positive and negative emotional cues and cognitive engagement is measured through goals achieved (Hookham, Nesbitt and Kay-Lambkin, 2016). Engagement is a complex process involving challenge, aesthetic appeal, novelty, interactivity, awareness, motivation, interest and emotion. Engagement with technology can improve user experience (Doherty *et al.*, 2018). Promoting user engagement for PwID should focus on minimising cognitive load by using graphics, animations, interactivity, choice and auditory output. There is no standard measure of user engagement as it differs according to area and demographic although subjective variables, such as a post-test questionnaire and objective variables such as using eye trackers can be examined. However, some of these methods may be unsuitable for PwID. Hookham *et al.* (2016) suggest that assessing different components of engagement (behavioural, affective and cognitive) allows for a more targeted measurement of its various aspects: behavioural engagement can be measured by recording time spent focused on a task, affective engagement by observing emotional cues, and cognitive engagement by testing whether the user reaches their goal. Measuring engagement for PwID will be described in more detail in the Methodology chapter.

Aesthetics refers to the look of the application. There is a debate around whether aesthetically pleasing applications are easier and more entertaining to use. Researchers have different opinions on this matter (Seckler *et al.*, 2015). On the topic of text for users with ID, it should be a sans serif font for improved readability, as well as a background with no pictures or patterns (Matausch, Peböck and Pühretmair, 2012). There are studies that look at different fonts and their readability, using both ID participants and neurotypical participants. In 2013, Rello and Baeza-Yates conducted a study which tested a wide variety of fonts' reading speeds and comprehension on learners with dyslexia. The researchers found that the fonts Helvetica, Courier, Verdana, CMU and Arial significantly increased readability for users with dyslexia. The study highly recommended the use of Courier, citing it's high reading performance and

user's subjective preferences. Colour was one of the factors analysed in a study with 194 participants that examined how aesthetics were perceived based on design of a website. (Van Calis *et al.*, 2025). Results indicated a blue hue was the most aesthetically pleasing colour. Color contrast was identified as a significant design element influencing readability, preferably with calm color schemes such as black, white, and (light) blue.

2.7. Summary

This *CyberSafe* research study is grounded in the social shaping of technology (SST) perspective, digital divide and social justice theories. Together, these frameworks provide a robust alternative to technological determinism, which inadequately accounts for the lived realities, power relations, and institutional contexts shaping technology use by PwID. SST conceptualises technology not as an autonomous or inevitable force, but as a product of social, cultural, political, and institutional processes (MacKenzie & Wajcman, 1999; Dutton, 2012). From this perspective, technologies are actively shaped through negotiations among multiple actors, including designers, policymakers, organisations, families, supporters, and users themselves. This is particularly salient in the context of PwID, whose access to and use of digital technologies are often mediated by support structures, funding mechanisms, safeguarding practices and policy decisions, rather than individual choice alone.

The concept of technology affordances further strengthens this analysis by focusing on the possibilities for action that technologies offer PwID, while recognising that these possibilities are relational and context-dependent rather than fixed or universal (Norman, 1999; Hutchby, 2001). Affordances are realised differently depending on users' capabilities, goals, social environments, and available supports. For PwID, this means that the same technology may afford empowerment, participation, or learning in one context, while affording exclusion, surveillance, or risk in another. This aligns with SST's emphasis on the co-creation of technology and social practice (Orlikowski, 2000).

Social Justice Theory also contextualises online vulnerability within broader systems of digital exclusion and ableism in this *CyberSafe* study. Studies have shown that increased risks of cyberbullying, exploitation, and online manipulation among PwID are largely

attributable to gaps in accessible education and support (Normand and Sallafranque-St-Louis, 2016). Designing accessible cybersafety applications thus functions as a social justice intervention, addressing systemic inequities rather than individual limitations.

This chapter explained the digital divide theoretical framework and the more recent term of “digital lag” as they apply to PwID. The importance of digital literacy and cybersafety for this vulnerable user group was highlighted as well as the lack of suitably designed educational resources in this field. The importance of assistive technology as a gateway for PwID was explored in the historical context of research developments over the last 15 years. Designing for eLearning for people with ID was discussed. User-centred, participatory and codesign approaches were explained and explored as approaches to interface design in the context of this user group. The literature review culminated with general design principles for Interface Design for PwID and a discussion of dimensions of user experience i.e., usability, engagement and aesthetics as they related to the target user group.

3. METHODOLOGY PART 1

3.1 Introduction

This chapter addresses methodological considerations and the research context setting for this *CyberSafe* study and provides theoretical discussion around these areas. The purpose of this Methodology chapter (Part 1) is to discuss the research approach adopted in this *CyberSafe* study under the following headings:

- theory and research objectives
- research questions
- data collection methods, underpinned by the philosophical paradigm and the assumptions the researcher brought to the study
- types of data needed during the Phase 1 study with the stakeholders and at each of study's data collection points with young adults with ID.
- previous research on apps for people with ID
- discussion of research methods chosen for this study
- ethical considerations

Chapter 4 (Methodology Part 2) will then describe in detail the specific research methods utilised at each of the four data collection points of the study, in terms of participant details and demographics, procedure, and materials. These four data collection points included the study with the stakeholders and then 3 rounds of data collection with young adults with ID.

3.2 Theory underlying Research Objectives

This *CyberSafe* study draws on an integrated theoretical framework combining Social Shaping of Technology (SST), Digital Divide and Social Justice theories to examine digital technology design for PwID. This study research is theoretically grounded in Social Shaping and Social Justice Frameworks, which integrates digital divide theory, disability studies, capability theory, and human-rights principles. This framework views digital inclusion for PwID disabilities as shaped by the interaction between technological design, social structures, institutional contexts, and power relations. It emphasises that digital inequality is

not merely a matter of access or technical skill, but a form of structural injustice that must be addressed through empowerment, participation, and rights-based inclusion. At its core, this study draws from Social Shaping of Technology theory, combined with Social Justice theory (SSJ), which argues that technologies are not neutral artefacts but are co-constructed through complex interactions between designers, users, institutions, and cultural norms (MacKenzie and Wajcman, 1999). Within the context of PwID, SST helps to explain how issues such as affordability, accessibility, policy gaps, and support ecosystems shape both the design and uptake of digital technologies. Applied to cybersafety education, Bell's social justice framework (2016) highlights the importance of participation, agency, and empowerment. The framework is further strengthened by Participatory Action Research (PAR) approaches and inclusive design methodologies, which emphasise empowerment, participation, and co-creation (Sanders and Stappers, 2008). PAR is closely aligned with disability rights principles such as "Nothing About Us Without Us" (Charlton, 1998) and reinforces the idea that PwID should be active contributors in the design of digital tools intended for their use. This approach is particularly relevant in digital inclusion research, where participatory and co-design practices have been shown to enhance usability, relevance, and agency (Bayor *et al.*, 2021).

Cresswell and Cresswell (2018) discuss different research approaches which are themselves informed by philosophical world views or paradigms (See Figure 7). Research approaches are "plans and the procedures for research that span the steps from broad assumptions to detailed methods of data collection, analysis, and interpretation" (Cresswell and Cresswell, 2018, p.18). I, in co-operation with my supervisors, took an overall decision about which approach to adapt to study this topic. This decision was informed by the following three components:

- the philosophical assumptions the researcher brought to the study,
- procedures of inquiry (called research design),
- and specific approaches to research methods of data collection

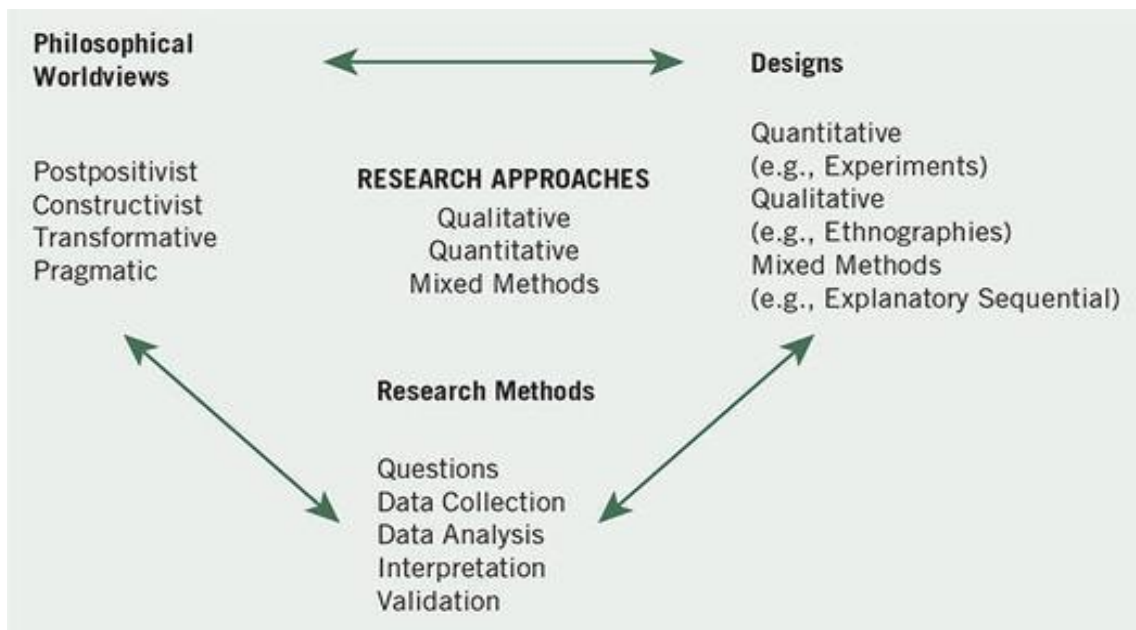


Figure 7 Framework for Research—The Interconnection of Worldviews, Design, and Research Methods (Source: Cresswell and Cresswell, 2018)

The selection of the research approach was based on the nature of the research problem or issue being addressed, the researchers' personal experiences, and the audiences for this study. This section discusses *research approaches*, *research design*, and *data collection methods* as three key areas as they apply to the *CyberSafe's* study. This helps to illuminate the study from broad philosophical constructions of research to finally discussing the more specific procedures or methods for each of the phases of the study in Methodology part 2.

Table 5 Three components of scientific research paradigm

Components of research paradigm	Description
Epistemology	General parameters and assumptions associated with an excellent way to explore the real-world nature.
Ontology	General assumptions created to perceive the real nature of society (in order to understand the real nature of society).
Methodology	Combination of different techniques used by the scientists to explore different situations.

(Source: Žukauskas, Vveinhardt, and Andriukaitienė, 2018, p. 125)

A research paradigm is an approach to research, which affects the analysis, and interpretation of the topic and research results (Easterby-Smith *et al.*, 2002). As this study was adopting a scientific research paradigm, the main parts of this approach were considered (see Table 5 for a description of the 3 main components). According to Crotty (2015, p. 10), ontology and epistemology are worldviews, which embody “a certain way of understanding what is (ontology) as well as understanding what it means to know (epistemology)”. Often included in the classification of scholarly paradigms of research (Žukauskas, Vveinhardt, and Andriukaitienė, 2018) are the three paradigms (positivist, constructivist, and critical) which are different by ontological, epistemological, and methodological aspects.

CyberSafe's research was underpinned by ontological and epistemological assumptions. MacKenzie and Knipe (2006) state that in most common definitions, it is claimed that methodology is a general approach to research related to the paradigm or theoretical foundation, and the method includes the procedures, or tools used for data collection and analysis. This *CyberSafe* study uses a mixture of constructivist and interpretative paradigms in its approach. The constructivist interpretative approach focuses on the data and analysing it to collect information on the participants' perspectives and experiences. Therefore, for this research study, I adopted a constructivist interpretative approach as it allowed me to analyse patterns in the data collected to see how students interacted with the *CyberSafe* application and their perspectives on cybersafety.

This study adopted primarily a qualitative research design. Creswell and Creswell (2018) outline five types of qualitative research approaches. These approaches are used as a framework for selecting and designing qualitative research studies. *CyberSafe* adopted a phenomenological and grounded theory aspects in that I sought to understand the essence of the experience of PwID's experience online and the various ways these individuals interpret and make sense of it. This thesis aimed to explore the subjective perspectives and meanings attributed to a particular phenomenon (in this case cybersafety) as described by individuals who have experienced it. *CyberSafe* adopted an iterative and inductive approach in some of its data analysis, especially in analysing the lived experience of young adults with ID online. The aim here was to develop insights or explanations emerging from the data.

CyberSafe involved collecting and analysing data simultaneously, allowing emerging themes and concepts to shape the ongoing data collection and analysis. The focus was on generating themes that emerged from the data rather than testing pre-existing theories.

The research into and development of the *CyberSafe* prototype is an educational response to the lack of resources currently available on online safety practices for young adults with ID. One of the aims of this thesis was to explore, adapt and design a methodological approach to the practice of user-centred design for this user group. To this end, the application developed as part of this study, took an inclusive and user-centred design approach to creating an educational application, whose aim was to meet the cybersafety requirements of young adults with ID. In order to understand the unique requirements, difficulties, and goals of PwID in terms of access to and use of digital technology, researchers can interact directly with PwID, their families, and support networks. Participatory Action Research (PAR) is a research methodology that actively incorporates the community being examined. PAR adopts the Empowerment Perspective which highlights the transformative potential of digital technologies in empowering individuals and communities. It recognises that digital inclusion goes beyond mere access to technology and emphasises the importance of digital literacy and skills development. By equipping individuals with the necessary knowledge and skills to use digital technologies effectively, they can access educational resources, employment opportunities, and social networks, thereby enhancing their social and economic well-being. The empowerment perspective also emphasises the need for community engagement, collaboration, and participatory approaches to bridge the digital divide. PAR as employed by Edler's research (2020) in a European research project provided recommendations for inclusive participatory research and development (<https://www.easyreading.eu>). PAR is not fully implemented in *CyberSafe* as participants are not co-researchers but they are involved in the form of participatory co-design workshops guided by Edlers (2020) recommendations.

3.3 Research Questions

The main research questions that this study addressed are:

- What issues and challenges do stakeholders identify around cybersafety for this user group?

- What key themes around cybersafety do young adults with ID report?
- What aspects of a participatory design/co-design workshop work for this user group?
- What usability, satisfaction and engagement issues did this user group report when using the *CyberSafe* prototype, which was developed using a UCD methodology?
- What is an effective process of applying User-centred Design (UCD) methodology to the design of an educational cybersafety application for young adults with ID?

3.4 Data Collection Methods

3.4.1 Research paradigms

3.4.1 Bias and Locating the Researcher within the Research.

Researcher bias refers to the influence a researcher's personal beliefs, values, or expectations may have on the research process, from the formulation of research questions to data collection, interpretation, and reporting. It can manifest consciously or unconsciously, potentially compromising the validity and reliability of findings. As Robson (2017) notes, researcher bias can subtly shape how questions are framed, which participants are selected, and how responses are interpreted, often reinforcing pre-existing assumptions. In qualitative research, this bias is particularly salient due to the subjective nature of interpretation; however, even in quantitative studies, decisions around data analysis or omission of outliers may reflect underlying biases (Maxwell, 2013). To mitigate this, researchers are encouraged to engage in reflexivity which is the ongoing process of critically examining one's role, assumptions, and influence throughout the study (Berger, 2015). Transparent reporting, triangulation and peer debriefing are among the strategies used to enhance credibility and reduce the impact of bias (Lincoln and Guba, 1985). Ultimately, recognising and addressing researcher bias is essential for maintaining ethical integrity and producing trustworthy, balanced research outcomes.

The fact that I had conducted some previous research in the domain area with similar target users could possibly have influenced this present research study. Therefore, I had to be constantly alert to my biases and make sure that I was not creating “a blurred

relationship between me as the researcher and the research itself” (Muncey, 2010, p.33). Rudge (1996), however, states that being an insider could be an advantage because, as an insider, I was aware of the history and reasons behind any research themes, which may emerge. This observation is true in my case because in my experience, there are so few practice based cybersafety research initiatives for this user group in Ireland and abroad in this domain area (examples are outlined in Section 3.7.1). Because most of these examples are research projects, these initiatives are often not sustained once funding ends or the research studies come to the end of their lifecycles. I, therefore, was keen to highlight the importance of developing sustainable user-centred eLearning cybersafety resources for PwID. I needed to be careful of any assumptions I may have had that this technology would work effectively for them, based on personal experience. Working on a subject in which I am passionately interested, I question whether it is possible for me to be a totally objective researcher. Even in a more positivist style of research, which relies on empirical data from surveys, experiment and observational techniques, I do not submit to “a naïve realist view of qualitative research” where the researcher can simply “give voice” to their participants (Braun and Clarke, 2006, p.7). As Fine (2002, p.218) argues, even a “giving voice” approach “involves carving out unacknowledged pieces of narrative evidence that we select, edit, and deploy to border our arguments”. I believe that the data will most likely have some biases from the researcher: for example, choice of subject matter under study, personal assumptions, and a particular methodology. I came to this study with many assumptions about the themes in the research and the questions I would be asking my participants. Those assumptions had to be scrutinised. They came about as a result of my previous knowledge, both personally and theoretically; my reading of the literature, my lived experience of previous research, my personal values and how ‘life’ and study have impacted on my thinking (Matthews and Ross, 2010, p.57). Likewise, my participants came with their own set of assumptions and answers to the questions, from their perspective (Simpson, 2018). With this awareness, I interpreted the data through my lens while being aware of the connection between who I am and how I interpret and present the findings. As such, my subjective awareness was essential to this task. As this study’s research data was primarily qualitative, it was imperative to locate the researcher within the research. It was important

for me to acknowledge my own interest in the research and my theoretical position and values in relation to qualitative research.

Table 6 Research data collection methods

Pragmatism	Positivism	Realism	Interpretivism
Popular data collection method	Mixed or multiple method designs, Quantitative and qualitative	Highly structured, large samples, Measurement, quantitative, but can use qualitative	Methods chosen must fit the subject matter, quantitative or qualitative Small samples, in-depth investigations, qualitative

(Source: adapted from Saunders *et al.*, 2012, p. 165)

Using the interpretivistic approach, I wanted to use thematic analysis as a method, in order to reflect the reality of the lived experience of the participants involved at all stages of the *CyberSafe* research study. “It is important that the theoretical position of a thematic analysis is made clear, as this is all too often left unspoken. A good thematic analysis will make this transparent” (Braun and Clarke, 2006, p.9).

3.4.3 Thematic analysis method

Thematic analysis is a flexible way of analysing data that works with mixed method research and many other approaches particularly qualitative (Percy, Kostere and Kostere, 2015). Thematic analysis is useful to researchers who are examining rich and valuable data that must be presented in an easily readable fashion for non-academic readers (Braun and Clarke, 2006) as it usually involves a combination of bottom-up (inductive) and top-down (deductive) approaches. The inductive approach allows identifying themes driven by the data per se, while the deductive approach involves the use of a series of concepts or existing theories for themes identification. Typically, the inductive approach is used when there is a lack of research in the area and categories are created from the data (Chapman, Hadfield and Chapman, 2015). This study used a combination of both approaches. The deductive approach was based on a pre-existing and highly structured usability and engagement themes framing (i.e., a series of concepts) and on structured observations collected by the researcher. The inductive approach was utilised when themes were identified from the data collected in the interviews and empathy workshops, capturing the actual voice of the

participants. The inductive approach was used in the analysis of the participants' comments interacting with the application during the lab observations.

Good practice in qualitative analysis recommends evaluating the intercoder reliability (ICR) of a coding framework (Conner and Joffe, 2022). ICR is a disputed subject in the qualitative research community. Some researchers argue that it is an inappropriate or unnecessary step within the goals of qualitative analysis, because it fundamentally contradicts the interpretative agenda of qualitative research (Braun and Clarke, 2022; Hollway and Jefferson, 2013). Others argue that performing and reporting ICR can help assure readers that the coding analysis was executed in a conscientious and consistent way (Kurasaki, 2000). Some journal editors and reviewers can request or require a measure of ICR in the process of evaluating and publishing qualitative studies (Wu et al., 2016). Campbell et al. (2013) state that in many qualitative research projects, particularly for early-career researchers, a single coder codes the majority of the data. The importance of procedural auditability, as asserted by Nowell *et al.* (2017), in this *CyberSafe* study was observed through the provision of decision trails such as thematic coding maps and raw data. These measures were taken to foster credibility, trustworthiness and replicability. I am aware of the debate around ICR but because this is a single authored Ph.D., I instead want to emphasise the importance of trustworthiness. Guba and Lincoln (1985) played a foundational role in reshaping how quality and rigour are conceptualised in qualitative research, proposing trustworthiness as a more appropriate framework than traditional notions of reliability and validity drawn from positivist paradigms. They argued that the application of reliability, understood as consistency of results across repeated trials, is incompatible with the interpretivist foundations of qualitative inquiry, where reality is seen as multiple, subjective, and context-bound. Instead, they introduced four criteria for trustworthiness: credibility, transferability, dependability, and confirmability, each roughly corresponding to internal validity, external validity, reliability, and objectivity in quantitative traditions. For example, *dependability* acknowledges that qualitative findings are influenced by context and time, yet still calls for transparent documentation of research processes to allow for reasonable consistency. This shift reframes the discussion from striving for replicability to demonstrating rigour through methodological transparency and reflexivity. Critics have sometimes challenged the ambiguity of these criteria and their

operationalisation (Tobin and Begley, 2004), but the trustworthiness framework remains a cornerstone of qualitative research quality assessment. It acknowledges the epistemological underpinnings of qualitative work and supports a more nuanced understanding of rigour that is suited to the complex, interpretive nature of social inquiry. As such, *CyberSafe's* research design sought to establish trustworthiness rather than a single truth as emphasised in concepts of reliability. The use of thick descriptions as part of the audit trail is part of the trustworthiness phenomena in qualitative research especially when it involves a lone researcher as in this Ph.D study. The concept of thick descriptions is fundamental to qualitative research and is closely associated with the interpretive paradigm. Popularised in anthropology by Clifford Geertz (1973), thick descriptions refer to richly detailed accounts that go beyond mere surface facts to interpret the underlying cultural or social meanings of human actions. In the context of qualitative inquiry, Norman Denzin (1989) extended the notion of thick description to encompass not only the detailed narration of events or behaviours but also the researcher's interpretation of those events in relation to context, intention, and social significance. For Denzin (1989), thick description is an essential component of interpretive ethnography, allowing the researcher to provide deep insights into the lived experiences of participants. It involves situating actions within their broader cultural and social frameworks, thereby making visible the meanings that participants themselves attribute to their experiences. This level of depth is especially valuable when working with marginalised groups, such as PWID, where understanding the contextual nuances of communication, behaviour, and interaction is vital to producing ethical and inclusive research. Thus, thick descriptions not only enhance the credibility and transferability of qualitative findings (Lincoln and Guba, 1985) but also supports a reflexive engagement with the data, positioning the researcher as an interpreter rather than a passive observer.

Braun and Clarke's (2022) reflexive thematic analysis was chosen for this research thesis and implemented. It is a widely recognised and flexible method for identifying, analysing, and interpreting patterns of meaning (themes) across qualitative data. Rooted in a reflexive and interpretivist paradigm, the approach emphasises the active role of the researcher in theme development, rather than treating themes as objective entities that emerge passively from the data.

1. Familiarisation with the Data.

This initial phase involves immersing oneself in the dataset, which may include interview transcripts, field notes, or other textual materials. Researchers read and re-read the data to develop a deep understanding and begin noticing initial ideas or patterns. This process is both intuitive and analytical, forming the foundation for the rest of the analysis.

2. Generating Initial Codes.

In this phase, researchers systematically work through the data to identify and label features of interest. Coding involves assigning short labels (codes) to sections of data that appear meaningful or relevant to the research questions. Codes are not fixed and can be semantic (explicit) or latent (underlying), depending on the analytical approach.

3. Constructing Themes.

Once the dataset is coded, the researcher begins to examine the relationships between codes and cluster them into potential themes. A theme represents a broader pattern of shared meaning supported by a central concept. At this point, the analysis becomes more interpretive, moving beyond data description to conceptual understanding.

4. Reviewing Themes.

Themes are refined by checking them against the coded data and the dataset as a whole. Some themes may be merged, split, or discarded if they lack coherence or are not well supported. This stage ensures that themes are distinct, internally consistent, and meaningfully represent the data.

5. Defining and Naming Themes.

Each theme is clearly defined and named in a way that captures its core meaning. This involves articulating what each theme is about, how it relates to the research question, and what aspect of the data it captures. This stage refines the narrative of the analysis and prepares for writing up.

6. Producing the Report.

The final phase involves synthesising the analysis into a coherent narrative. Themes are illustrated with rich, relevant data extracts and are discussed in relation to the

research question and existing literature. This is not just a description but a critical and interpretive account of the data.

Braun and Clarke (2022) stress that this framework is recursive, not linear—researchers may move back and forth between phases, reflecting on decisions and refining their interpretations. Importantly, the reflexive approach recognises that the researcher’s theoretical positioning, values, and insights are integral to the process, rather than something to be bracketed out. *CyberSafe*’s codes and themes were refined through its recommended steps. In recognition of this framework’s emphasis on establishing rigour in thematic analysis, including quotations, as an essential element of the final report, was implemented. This inclusion serves to demonstrate asserted themes, illustrating the flavour, prevalence of themes, and the ‘complex story’ of the data. Quotations were integrated with theoretical conceptualisations to demonstrate the merit and validity of the study (Braun and Clarke, 2006).

3.4.4 Overview of available User-centred Design tools

As stated earlier in Chapter 2, user centered design (UCD) describes a design process that involves the potential user at all stages: requirements, prototyping, testing and evaluation (Sharp, Preece and Rogers, 2019). UCD, a philosophy that places the user at the centre of all design activities, demands that these users are included at every stage that is possible. Research and development for PWID is mainly conducted through interviews with experts and through “a mediated understanding of the user” (Meisenberger et al., 2020, p.6). The essential need for involvement in the design process is much less achieved for this user group (WebAim, 2020). Research studies emphasise that UCD is an indispensable aspect of research in accessibility, assistive technology and digital inclusion (Weber and Edler, 2010; Edler, 2020). The UCD approach was the best fit for this thesis and importantly its research questions. This study adapted the user centered design (UCD) process to create the *CyberSafe* application itself. This approach focuses on involving and designing for the intended users and their need’s (Abrams et al., 2004). In accordance with these recommendations, the principal target users of *CyberSafe* were at the core of this research study. The international standard (ISO) provides the basis for many UCD methodologies. The literature is sparse on cataloguing or organising the various UX methods.

There are various textbooks (Hartson and Peyla, 2012; Lowdermilk, 2013) but the area is constantly evolving. Table 7 shows some sample UX methods, some of which were used in each phase of the *CyberSafe* UCD process. The UCD tools utilised in these phases are described in more detail in a later section 3.9 (Choice of Methods summary).

Table 7 Sample UX methods (Kirstin Hierholzer, Director of User Experience, University of Oregon)

Research	Concept	Design	Development	Implementation
Stakeholder interviews Metrics Competitive Analysis	Card Sorts Information User Stories Empathy Maps	Wireframes Paper Prototypes Interactive Prototypes Usability Testing	Usability Testing Bug Testing Content Creation	Usability Testing Bug Testing Post-Launch Surveys Metrics to Demonstrate Improvements/ Success Continued User Research
State of the Art Surveys Interviews Focus Groups Ethnographic studies Field Studies Task Analysis Diary Studies	Journey Maps Personas Content Inventory Content Maps Accessibility Planning			

3.5 Discussion of research methods chosen

This section will discuss available research tools with the advantages and disadvantages of each option.

3.5.1 Interviews - Types of Interviews

A qualitative approach, using interviews and questionnaires, allows for the researcher to get explanations otherwise unobtainable using quantitative methods (Percy, Kostere and Kostere, 2015). “Qualitative data sets typically are drawn from fewer sources (e.g.,

participants) than quantitative studies, but include rich, detailed, and heavily contextualised descriptions from each source” (Levitt *et al.*, 2018, p.27).

Sharp, Preece and Rogers (2019) reported online face to face interviews are advantageous as participants are more relaxed in their own environment and have added security with the knowledge, they can end the interview whenever they chose by closing the application. Semi-structured interviews combine the benefits of unstructured and structured interviews. In this way, I was able to obtain in depth exploratory information by asking probing questions from the expert stakeholders. This included issues, previously unconsidered by the researcher, typical of an unstructured interview, while also allowing for a clear guided process to identify specific issues typical of a structured interview. Kallio *et al.* (2015) reported that semi-structured interviews are both versatile and flexible. They are advantageous due to their reciprocity which enables the interviewer to create follow up questions based on participant responses and allows space for individual verbal expressions. Semi-structured interviews enhance trustworthiness of qualitative research due to its basis of previous empirical knowledge. This increases study dependability, confirmability, and credibility.

3.5.2 Surveys and Questionnaires

Surveys and questionnaires have the capacity to collect demographic data and stakeholders’ opinions, attitudes and opinions on the topic of cybersafety for PwID. Online surveys are convenient, flexible, quick, and allow for a global reach (Evans *et al.*, 2005). Questionnaires can gather quantitative and qualitative data by using closed and open-ended questions (Sharp, Preece and Rogers, 2019). The combination of both qualitative and quantitative methods is known as mixed methods research (Schoonenboom and Johnson, 2017). The goal of mixed methods research is to combine both qualitative and quantitative components which expands and strengthen a study’s conclusions by heightening validity and reliability to the research (Schoonenboom and Johnson, 2017). Davies (2020) reported online surveys help ensure anonymity. Furthermore, since online surveys are self-complete, this may improve receiving valid responses and improve response rate. Visually appealing questionnaire helped to break up the monotony of the survey for PwID support workers. Sheard (2018) reported that to ensure trustworthiness and meaningful results, data

preparation should remove any unnecessary data which may contain outliers or incomplete data. Outliers and incomplete data threaten the validity and reliability of a study's results and should therefore be removed.

3.5.3 Group Workshop for PwID

A group workshop was another research method used to gain an early understanding of the ID user group and to learn their goals and the tasks they expected to accomplish on any application (Goodman, Kuniavsky and Moed, 2013). According to Elsdén, Tallyn, and Nissen (2020), there are many ways to approach running a UX design workshop. This might range from creating spaces for particular communities of users, experts or stakeholders to share their perspectives around a subject or technology (Vines *et al.*, 2012); brainstorming activities to come up with new design opportunities (Andersen and Wakkary, 2019); or perhaps garnering feedback on a particular design artefact (Lawson *et al.*, 2015). In practice, UX design workshops are particularly popular as an approach or method by which to engage participants in the creative process. These workshops ask users and stakeholders to contribute to some kind of creative activity. Some researchers reflect realistically, on UX workshops as a research method and see “a tension between more open-ended, exploratory and unpredictable activities, and more controlled, and structured data activities that lead to defined outputs” (Elsden, Tallyn, and Nissen, 2020, p.247). Workshops can be fun for participants, but without thoughtful and skilful management, it can become challenging for the organiser to consolidate outputs into empirical insights. They recommend imposing structure, and that decisions about structure could also be better negotiated ahead of a workshop with participants. However, they do not recommend data capture methods like audio or video recordings as they can intrude on flow and privacy, and they can be difficult to analyse afterwards. They state that there are considerable tensions between: the workshop as an experience for participants; as a resource for design; and as a tool for research. Data collection at a UX workshop can be challenging too. One approach can be to prepare highly structured tasks with which the participants can engage (Vines *et al.*, 2012). These competing priorities have to be skillfully negotiated by researchers. This researcher from past experience believes that preparation and planning are key, with clear goals and outputs from each workshop.

According to Kaplan et al. (2010), there are 5 common types of UX workshops:

- **Discovery workshops:** Communicate to stakeholders about the project and create plans and milestones
- **Empathy workshops:** Work with stakeholders and users to understand and prioritise user needs before designing a solution
- **Design workshops:** Rapidly generate and discuss a wide set of ideas with a bigger group of attendees
- **Prioritisation workshops:** Build consensus on which features users value most
- **Critique workshops:** Ensure that design decisions have properly aligned to user needs

This researcher employed empathy, design and prioritisation workshops as a UX research tool. Pitfalls of these kind of workshops can include the wrong people showing up, one person dominating the group and no shows. Thorough preparation, a good screener, a carefully chosen target audience, and asking some key questions at the beginning of the research will minimise this situation, but it still happens (Goodman, Kuniavsky and Moed, 2019). Ideally, there should be five to six participants in each focus group. If the group is too large, participants with intellectual disabilities may find it difficult to take part. This could be because of a fear to speak out in a crowd or because of cognitive impairments and distractions from other group members or speech and hearing difficulties (Barrett and Kirk, 2000; Fraser and Fraser, 2000). My supervisors and I agreed that small groups were needed to achieve better results.

3.5.4 Personas and requirements

“A persona is a description of a fictitious user; a user who does not exist as a specific person but is described in a way that the reader can recognise the description and believes that the person could exist in reality” (Nielsen, 2013, p.1). Personas are used as a design and a communication tool in the user-centered design process. The word persona has been derived from Latin, and means “the mask of an actor,” (Nielsen, 2013, p.1). The term is linguistically linked to the list of characters in a theatre drama. It represents the voice or

thoughts of a particular person, the needs of whom, the UX designer wants to meet in their prototype. Blomquist and Arvola (2002) state that a persona is a very typical example of a certain person that is given a name and a face, and is described in terms of needs, goals and tasks. It is difficult to find literature studies that examine the advantages and disadvantages of personas. However, Nielsen and Hansen (2014) reviewed six studies that used personas in different contexts.

Sample Persona: Anna **Age: 18**



Applied Leaving Certificate completed

Goals and motivations
Anna has Down syndrome, a mild intellectual disability that manifests itself in limitations in maths and social situations. However, Anna has a great singing voice. She explained that when she loves to sing, she feels liberated from her social awkwardness and believes that she would enjoy having greater access to online forums where she could express herself freely.

Lifestyle: Singing, drawing, photography, pet dog and watching films

IT skill level
She has had some introduction to the internet while at school. Her parents are reluctant to allow Anna to have full access to the web. They would not allow her to have a Facebook account until she left school.

Attitude towards technology
 I love it – it’s easy to use and I understand how to navigate and stay safe online
 I like it and would like to use it more but I am not allowed to use it
 I don’t like it – I find it confusing to access and use

IT equipment
Desktop in the family room at home and phone but access to social media disabled.

How this person could use the internet?
Social Media (Facebook and Snapchat in particular), Netflix and on-line story writing apps

How will this person use this cybersafety app?
Anna is keen to learn all aspects of online safety.

Figure 8 Sample Persona

An overview of the findings in this literature reveals that personas have benefits. Personas help put the users need in focus and they uncover designer presumptions and challenge deep-seated and longterm assumptions about the users (Miaskiewiczza and Kozarb, 2011). The target users for this *CyberSafe* study have interesting lives, interests and hobbies (see Anna's sample persona in Figure 8). Anna is a very typical example of a certain person that is given a name and a face, and is described in terms of needs, goals and tasks, on which the prototype design had to be focused. Personas also help designers and developers realise how the users are different from themselves (Miaskiewiczza and Kozarb, 2011). This is pertinent in this study's research as the target users have specific interface needs in terms of information design. It was vitally important to ensure that the study addressed the correct issues.

There is a danger that designers and researchers promote their designs and impede users influencing the design for themselves (McGinn and Kotamraju, 2008). This is particularly important, as stakeholders tend to believe that they know best. However, personas need to be created at the beginning of a design process. Unfortunately, researchers have pointed out that this does not always happen and against recommendations, personas are created throughout the design process (Chang, Lim and Stolterman, 2008). These researchers state that personas may not be created entirely from research data: designers often use input from their own assumptions, not just from user studies data and personas can have incorrect descriptions. Often, personas are utilised in the design process, but only for helping communications (Matthews, Judge and Whittaker, 2012). Often, designers prefer to use scenarios instead of personas and sometimes, there is often a poor inclusion of the method into the design process (Blomquist and Arvola, 2002). Some designers find personas are written in language that is too abstract and which is not personal enough. Programmers often criticise certain details in the persona outline (Gudjónsdóttir and Lindquist, 2008). By being aware of the pitfalls above, I aspired to avoid these disadvantages. From all the research gathered from the stakeholders and user workshops, personas and the requirements for the design phase were defined. The two *CyberSafe* personas, named Mary and John, which were based on the findings of the empathy workshops conducted, are available to view in Chapter 5, "The *CyberSafe* App

Design". The personas captured the basic demographic and behavioural information, for the PwID user. They detailed the goals and frustrations of the users.

3. 6 Types of Data Needed

This section will present the data that emanated from the 3 stages of user-centred design which resulted in four distinct datasets. Initial data was collected with four expert interviewees who worked with PwID. There were three subsequent data collection points with young adults with ID. Therefore, the four datasets in total to collate and analyse included:

- Stakeholder data,
- PwID empathy workshop data,
- Codesign workshop data with PwID,
- Lab sessions data using the *CyberSafe* prototype.

Specific participant data will be described in Section 4.3.

3.6.1 Dataset 1

The purpose of the qualitative approach to data gathering as adopted in the early phase of *CyberSafe* was to identify the main themes from stakeholders in the field. A first explanatory qualitative phase was used to build an interview instrument that best fitted the sample under study, to identify appropriate questions to ask in the follow-up mixed methods phase, or to specify variables that needed to go into a follow-up survey with a larger group (Cresswell and Cresswell, 2018). A predominantly qualitative research design incorporating interviews with stakeholders, and a survey, were deemed suitable to answer RQ1:

- RQ1. What are the main issues and challenges for stakeholders around cybersafety for this user group?

This approach produced thick descriptions with quotations from stakeholder participants describing their views and experience of cybersafety for PwID. This use of thick descriptions was part of the audit trail, which in turn was part of the trustworthiness phenomena in

qualitative research (Guba and Lincoln, 1985). A combination of one-on-one interviews with 4 expert stakeholders and a survey to discover support workers views on technology use by the target user group were employed as the aims were twofold:

1. To discover the experts' views on technology use by the target user group
2. To research cybersafety for the user group from the point of view of experts and support workers in the services at a point in time.

3.6.2 Dataset 2

Empathy workshops allowed for in depth examination of research question 2: What key themes around cybersafety do young adults with ID report? Empathy workshop groups were deemed suitable in this process as the aims were twofold:

- To discover the participants' experience of using technology applications
- To research cybersafety in the user group including cyberbullying, using recordings of the participants' views and experience.

3.6.3 Dataset 3

Running co-design workshops with some early-stage paper concepts and ideas allowed for an examination of research question 3: What aspects of a participatory design/co-design workshop work for this user group?

Inspiration for *the CyberSafe* co-design workshops and data collected came from Hendrik's approach (2015) and the framework from Sanders *et al.* (2010) and Bayor *et al.* competencies framework (2021). This competencies framework aligns with an asset –based approach which aims to identify and use existing assets, or strengths or competencies, to enable individuals to have more control over their health and wellbeing (McLean, 2015). A deficit-based approach, on the other hand, identifies problems or needs and solutions developed through resources that are often external to the target cohort and their stakeholders (Morgan and Ziglio, 2007).

Hendriks *et al.* (2015) explored the potential development of a dedicated methodological approach to enhance the participation of people with cognitive impairments in co-design. After consulting with 42 experts in different areas of cognitive impairment, the

group quickly concluded that their goal was much too ambitious. This is due to the heterogenous nature of people with cognitive disabilities. This deduction applies to persons with intellectual disability (PwID). This realisation then led to a change in their thinking, with the researchers concluding that a customised approach to co-design techniques should be based on the individual skills and impairments of participants i.e., a competencies-based approach. It was recommended by the experts that flexibility and creativity in adapting and adjusting existing codesign techniques to individual participants' abilities and limitations is essential. The challenge remains to decide how exactly to customise existing techniques. The researchers recommended that core guidelines learned while carrying out these adjustments should also be distributed widely to increase the knowledge of other researchers. However, they concluded that this body of work may take several years to accomplish, meaning it is necessary for researchers to seek out other avenues of support.

According to Visser (2005), co-designers should be seen and treated as the experts of their experience, and they should be provided the appropriate tools to express themselves freely. To be able to communicate freely, one must feel safe both physically and emotionally. In her book, McKercher (2020) explained that prioritising relationships is a key element of a fruitful codesign session. Without relationships, there is no trust, without trust there is no conversation and without conversation, the end-product will be inadequate. According to McKercher, the other very important element, especially designing with ID, is building capabilities. People need encouragement and support to feel free to share, not being afraid of saying or doing the wrong thing. Every single person has something to teach and something to learn. From my participation at various conferences in recent years, the general practice tends to be that researchers try to learn from other researchers and designers. However, it is very rare that they are able to directly re-use a method or approach from other researchers and designers. Each codesign activity demands a customised approach, but still requires the researchers' creativity to make further adjustments according to the specific goals and competencies of participants in the study. Hendriks (2015) maintained that the focus in co-design should be on so-called 'method stories' as recommended by Lee (2014). The focus in co-design should be on so-called "method stories" in the context of codesign with individuals living with disabilities. A focus on "what designers actually do and feel when making their methods work" (Lee, 2014, p.1) rather

than on the data, the interviews, or the observation notes as the end result of the followed method, is what Lee calls for in her work on cultural sensitivity in human-centered design. She finds that there is a tendency to overlook the designer's action in context or situated actions. This focus made me reconsider my approach to this method write up as such method stories focus on how innovative methods are made to work in reality, in a specific design setting, instead of how they ought to work in theory, in a controlled environment. Method stories are background narratives that detail the context, application, and adjustment of a technique and is one way to discuss this method-making process. They help in making clear not just the actual outcome of a codesign session (such as tangible artifacts or interfaces) but the story of how they came into being.

Sanders *et al.* (2010) developed a framework, which provides an overview of participatory design tools and techniques for engaging non-designers for specific participatory design activities. This framework inspired the design of content and data collection for the *CyberSafe* co-design workshops. It has three dimensions: *form, purpose and context*. Form describes the kind of action that is taking place between the participants in an activity, and is described as making, telling and/or enacting. The second dimension is purpose which describes why the tools and techniques are being used. This second dimension of purpose is described along four aims: 1) for probing participants, 2) for priming participants in order to immerse them in the domain of interest, 3) to get a better understanding of their current experience or, 4) the generation of ideas or design concepts for the future. Context describes where and how the tools and techniques are used. Context is described along these four dimensions: group size and composition, face-to-face vs. on-line, venue, as well as stakeholder relationships. Context in the case of the *CyberSafe* co-design activities involved groups of 6 participants in both workshops in a face-to-face scenario involving support workers/instructors present as stakeholders. Bayor *et al.* (2021) conducted a series of co-design exercises with 11 similar participants to design a SkillsTube app. They adapted their co-design activities based on observation of the participants' skills.

3.6.4 Dataset 4

Interaction with an early-stage prototype allowed for in depth examination of research question 4: *What usability, satisfaction and engagement issues did this user group*

report when using the prototype, which was developed using a UCD methodology? A lab workshop was deemed suitable for this research stage as the research intended to discover the users' experience of an early-stage prototype using an adapted usability questionnaire to capture the participants' views and experience. Observed usability data was collected via recorded researcher observations during the lab session as well as Camtasia recording of participant key strokes, as they navigated the application.

Observation is a widely used method in usability evaluation, particularly effective for assessing how users interact with digital interfaces or assistive technologies in real time. Unlike self-reported data such as surveys or interviews, observational techniques allow researchers to capture actual user behaviour, including task completion strategies, navigation patterns, and points of confusion or error (Barnum, 2011). Observational usability testing typically involves users completing a set of predefined tasks while being monitored by an evaluator, either in person or through screen recording tools. In this study, Camtasia screen recording software was used to document user interactions with the prototype, enabling the researcher to perform detailed post-session analysis of user pathways, hesitations, and errors. Camtasia allowed for repeated review of interactions, enhancing the reliability of observational findings and supporting triangulation with field notes and think-aloud data (Lazar, Feng and Hochheiser, 2017). The ability to rewatch interactions provided deeper insights, especially when working with PwID, where subtle gestures or pauses could indicate confusion or engagement. Observations can be either direct (in real time) or indirect (via recordings), and in combination with tools like Camtasia, they offered a robust approach for identifying usability issues and informing iterative design decisions (Nielsen, 1994).

Triangulation is a methodological strategy used in qualitative research to enhance the credibility, validity, and trustworthiness of findings. The concept involves the use of multiple data sources, methods, investigators, or theoretical perspectives to study a single phenomenon, thereby reducing the likelihood of bias and increasing the depth of understanding (Denzin, 1978). Denzin identifies four basic types of triangulation: data triangulation (using different sources of data), investigator triangulation (involving multiple researchers), theory triangulation (applying different theoretical frameworks), and methodological triangulation (using more than one method to gather data). For example, in

usability research involving PwID, a researcher might triangulate observational data, interviews and screen recordings to better interpret user behaviour and experience. This multi-angle approach helps validate findings by cross-verifying information and capturing different aspects of the research context (Patton, 1999). In doing so, triangulation contributes to a more nuanced, comprehensive, and trustworthy account of the research phenomena, aligning with qualitative research's aim to represent complex realities authentically (Flick, 2018).

To address Research Question 4, which examined usability, satisfaction, and engagement with the *CyberSafe* prototype developed using a user-centred design (UCD) approach, the study employed a triangulated approach grounded in observational methods. This stage of the research focused on gathering nuanced data to explore three specific aspects of the user experience: (a) the usability interface problems users encountered while navigating the application, (b) the extent to which users engaged with the prototype during the session, and (c) users' overall satisfaction with the application. By combining direct researcher observations, screen recordings via Camtasia, and user self-reporting through adapted usability questionnaires, the study enabled a rich analysis of behaviour, interaction patterns, and subjective perceptions. This triangulation of data sources ensured greater validity and depth in evaluating the application's effectiveness, particularly within a user group that may express feedback in both verbal and non-verbal ways, such as people with intellectual disabilities (PwID).

It was possible to measure cognitive engagement, in the lab sessions, by checking whether the user completed the intended task within the interface using the Camtasia recordings. Without observational methods, many usability problems would have been missed. Furthermore, the use of both observation and questionnaire methods along with analysis of qualitative and quantitative data is advisable in this type of research for this user group (Caliz *et al.*, 2016). The observational method of usability evaluation focused on usability and engagement of users during their interaction with the *CyberSafe* prototype during stage iteration testing and during the final evaluation phase. Prior to commencing this Ph.D., I found in previous studies, I conducted, with this target user group that this approach was suitable as the research aimed to analyse the interaction between the participants and the application. I had previously utilised an observational method, inspired

by Macedo and Trevisan (2013), who adapted the Detailed Video Analysis (Devan) method for testing usability and engagement with children with Down Syndrome (DS). Devan is a coding scheme for detecting usability issues in task-based products for adults by identifying indicators of these issues. Macedo and Trevisan (2013) adapted these indicators to reflect behaviour observed in children with DS. This current Ph.D. *CyberSafe* research study adapted the Devan method coding scheme for the final observational usability experiment and to analyse Camtasia recordings of participants' interaction with *CyberSafe*. Two actions in the adapted DEVAN method were excluded (Impatience and Random Actions) due to limited observation time. Additionally, based on Hookham *et al.*'s (2016) comparison of usability and engagement, three of the actions (Dislike, Passive, Bored) were considered better suited as measures of engagement along with the addition of codes to measure Positive/Negative Vocalisations and Positive/Negative Behaviour. Macedo *et al.* (2013) recommended this method as suitable for both experienced and inexperienced observers. See [Appendix N](#) for link to the coding frame from the adapted Devan method.

This observational approach was necessary to validate data from the adapted SUS questionnaires. Individuals with ID tend to have a natural inability to criticise. Additionally, the tendency to provide "friendly" responses and desire "to please" were observed that corresponds to the results of other researchers (Caliz, Martinez and Alamán *et al.*, 2016).

Thematic analysis was conducted on the data collected during the observations, which included screen capture of Camtasia recordings and the researcher's audio recorded comments from the users as they interacted with the application. A combination of both inductive and deductive approaches to the data analysis was utilised. As explained earlier, the advantage of this approach was the integration of themes derived from literature with themes that emerged from the data examined.

A usability task is an essential part of usability testing to provide clear instructions about what participants need to do. Good tasks are essential to having a usability study that results in accurate and actionable findings (NNgroup, 2021). This task list was provided to participants at each of the three lab sessions (see lab 1 task list at [Appendix G](#)) and was inspired by materials developed by Maloney (2012). Task understanding is a recurrent issue when testing with this population (Williams, 2015). An adapted accessible System Usability Scale (SUS) was created with smileometers for feedback to triangulate with

Camtasia recordings and the audio recordings of my observation in the lab sessions. The SUS created by Brooke (1996) met a big demand in the usability community for a scale that could effectively rate a user's subjective view of how usable an interface is. Bangor, Kortum and Miller (2008, p.574) found that the SUS is “a highly robust and versatile tool for usability researchers and practitioners”. In this *CyberSafe* study, the adapted System Usability scale (SUS) collected subjective usability ratings from the target users. This adapted SUS was developed in accordance with recommendations by Caliz *et al.* (2016) who employed a Smileyometer to gather participants' views on usability and engagement relating to each of the features tested. Four responses were available, ranging from ‘*very easy*’ to ‘*very hard*’ for usability, and ‘*liked a lot*’ to ‘*disliked a lot*’ for engagement (see [Appendix I](#) for sample).

In terms of self reported usability measures, Gibson, Dunlop and Bouamrane (2020) interviewed 12 experts in ID who highlighted response bias occurring in interviews involving open-ended questions with PwID. The experts stated that response bias tends to be prominent within the ID population. They suggested that adults with ID are often “people pleasing” and may provide the answers they believe are expected, rather than their own views. The experts suggested that it may be a relevant issue within closed questions, such as rating scales, where the users tend to select the most extreme options. In this *CyberSafe* study, support workers did take a positive role in highlighting response bias. As they were familiar with the individual with ID and their life experience, they could recognise when the responses were inaccurate.

3.7 Previous Research methods for apps for PwID

Seale and Chapwick (2017) conducted a review of current research and practice in the field of Internet use by PwID. They emphasised the lack of conceptual and theoretical frameworks for this area of research. They proposed that a mixture of quantitative and qualitative approaches is necessary to throw light on the issues in more detail. They propose that inclusive or participatory approaches where people with ID and their support staff are co-researchers, “working alongside academics to determine what questions are important to ask and how they should be answered” (Seale and Chadwick, 2017, p.2). Caton and Chapman (2016) reviewed ten papers, which explored social media use in people with ID and outlined that the main methods used in the studies were questionnaires, case studies,

interviews, participant observation, field notes and thematic analysis of previous material online. These research designs were primarily qualitative. Another study looked at a smartphone chatting application called AbleChat, which was developed for people with ID (Daems *et al.*, 2016). Semi structured interviews and questionnaires were used to discover the users' opinion and recommendations on the application.

3.7.1. State of the Art

In UCD methodology, a review of literature is complemented by a State of the Art review. This helps a user experience (UX) researcher learn more about trends in design and functionality of an application for a particular user group. This can be done by compiling a list of similar applications and evaluating aspects of their product's usability, functionality, features and interaction design.

Table 8 Summary chart of State of the Art projects

Name	Target users	Features	Content	Digital Interaction design
STAR (EU project) 2020 https://www.childnet.com/resources/2014-star-toolkit/about	Autism and ID (10-14 yrs)	5 sets of PowerPoints 4 animations Teacher worksheets	Main topics are Safety Trust Action Respect	None apart from watching 4 animations on project website
Safe Surfing (EU project) 2016 https://www.inclusion-europe.eu/safesurfing/	ID young people	PowerPoint lessons 4 videos	Facebook and browser safety. Dangers of the internet.	None apart from watching 5 videos
<u>Anti-Bullying Alliance</u>	Young people with ID	Report Youtube videos Guide for Teachers Leaflet for students	What is cyberbullying What to do when cyberbullied content	None apart from watching 3 videos
DisAbuse project at DCU's ABC (2017-2019)	ID adolescents and adults	1 out of a total of 6 modules concentrated on Cyberbullying	What is cyberbullying What to do	Interactive web materials on all 6 modules

META and DCU's ABC (2018-2021) https://antibullyingcentre.ie/use/	All primary and secondary students	Fuse project Modules primarily to train primary and secondary teachers	How to help Students identify intervene, report appropriately in bullying incidents.	None
Webwise (ongoing) https://www.webwise.ie	All primary and secondary students	Series of videos		None apart from watching videos
Cyber Smart Access (ongoing) https://www.esafety.gov.au/educators/classroom-resources/cybersmart-challenge	ID young people	Teacher-led activities using animated videos to introduce primary school students to key online safety issues	Cyberbullying, protecting personal information and sharing images.	None apart from watching animations on project website
TOZI app Vodafone Foundation and DCU's ABC (2021-2023) https://www.to-zi.com/	Teenagers aged 11-14	Educational video clips, My Space journal	The Cosmos – podcasts, videos and more... My Space – a totally private space to check in and chill out. Live Chat – a direct connection to Childline by ISPCC	Journal entries
DigiAcademy Digi Academy - Home Page	Young adults with ID	Accessible digital education platform	ID lead instructional videos	Some interaction on platform

In the case of this thesis, this State of the Art section looked for common features in existing instructional resources and applications for PwID in the area of cybersafety. A summary chart of such State of the Art projects is provided in Table 8 and each project is described, highlighting their main features and content and if they involved any interactive features or interaction design. This list is no means exhaustive and has been expanded, as relevant resources were discovered. It can be seen from the Table 8 summary that, while there are several Powerpoint resources with associated worksheets, with some supplementary video and animation material, there are very few online interactive educational digital resources which PwID can interact with on their own initiative. This is the gap, which this *CyberSafe* research study was designed to fill.

The purpose of this State of the Art section was to learn more about trends in interface design and functionality of an educational application for the targeted user group. It is evident from the last row in Table 9 *Summary of Competitor app features* that just three applications (DigiAcademy and Tozi app and the Disabuse resources (now discontinued)), offered an interactive element to students.

Table 9 Summary of Competitor app features

	Star	Safe Surfing	AntiBullying Alliance	Disabuse	ABC Fuse	Webwise	Cyber Smart	Tozi App	Digi Academy
ID Friendly	√	√	√	√	x	x	√	x	√
Teacher Resources	√	x	√	√	√	x	√	x	x
Powerpoints	√	√	√	√	√	x	√	x	x
Videos	√	√	√	√	x	√	√	√	√
Cyberbullying	√	√	√	√	√	√	√	√	x
Data Protection	√	√	x	x	x	√	√	√	√
Digital Interaction	x	x	x	√	x	x	x	√	√

The key goal of the Tozi mobile phone app was to address the growing problem of cyberbullying by developing an app that would provide key features and benefits for all users. In this case, children and young people aged 11-14 years were researched to address their overall online safety and well-being; while also gaining key insights to further research and inform future app development. Tozi is an engaging app but as it is aimed at adolescents, I think that it is too childish and does not contain enough educational content for *CyberSafe's* target user group, i.e., the needs of young adults with intellectual disability. DigiAcademy, developed as the output of an EU research project, is an inclusive digital skills education platform co-created with people with ID to deliver meaningful content deemed valuable by the community. With the app, learners can set their own learning plans.

3.8 Ethical Considerations

3.8.1 Overview

I completed an ethics module in spring 2020 in DCU in preparation for this research. As part of that module, the ethical approach for this study was analysed, considered and justified. I considered that the deliberations during that analysis, summarised in Table 10, are worth restating here in this thesis as they have widespread applicability. The analysis approach adopted is based on the four steps of the Nijmegen method of ethical analysis (Steinkamp and Gordijn, 2003) starting with the ethical problem. The values, challenges and barriers to the research as shown in Table 10 were explored in detail during the ethics module. As some of the participants in the proposed research study have poor to no literacy with IQ scores as low as 51-69, the moral problem was: under which circumstances, is it ethical to test the accessibility of web interfaces with users with mild intellectual disability? In other words, how can research be conducted ethically which treats these individuals with dignity and fairness?

Table 10 Ethical values and challenges of this research

Who?	Participants	Parents/Guardians	Stakeholders	Researcher	Society
What matters to them? Values	Equality, communication, relationships, freedom and socialisation	More independence through use of technology	Access to online education, socialisation, resources for training	Contribute to applied accessibility research. Make a contribution	Inclusion. More accessibility for all. Bridge the digital divide
Challenges/barriers/risks	Costs of equipment Inequality of access Cybersafety	Technical experience, attitude and concerns Dangers of cyber world, cyberstalking	Coercion. Mental Capacity for informed consent	Protect dignity of participants. Protect from exploitation	Costs of real accessibility

Based on following strictly the guidelines outlined under the Beauchamp and Childress (2011) principles, it was up to the Ethics committee at DCU and St John of God (SJOG) to make an assessment. The question was whether it was ethical to test the accessibility of this prototype with users with moderate and mild intellectual disability under the outlined specified circumstance and conditions. The ethical principles of autonomy (e.g.

issues of recruitment, informed consent, mental capacity, vulnerability, and coercion), nonmalfeasance, beneficence, fairness and justice were analysed. Risks were counterbalanced against the benefits of an accessible online life for the individuals with ID, stakeholders and society.

For this research study, the researcher submitted the application form and associated documentation to DCU's research Ethics Committee (REC) and ethical approval was granted. The researcher also went through a very lengthy and rigorous ethical approval process by St John of God prior to conducting this research. Both ethical approval letters are available in [Appendix M](#). In line with good ethical practice support, it was determined that staff would be present as they were familiar with the participant's style of communication. Their role was merely to assist PwID when difficulties or frustrations were experienced during user testing, rather than speaking for or on behalf of them. Services would determine whether participants had the capacity to give consent under the terms of the St. John of God ethics submission, and had the ability to communicate as determined by the Services. The collected data was stored in Google Drive by the researcher and supervisor at DCU. Identifiable data was not required. A detailed Data Protection form (30 pages long) was completed by the researcher, as a requirement for the SJOG data protection office. DCU's data protection office also carried out their own assessment of the data protection procedures. Responsibility for ensuring confidentiality of the data was taken seriously.

Participants with mild to moderate ID were invited to participate via a '*gatekeeper*' from SJOG Services. The researcher had established a good relationship with the '*gatekeeper*' Program Manager at SJOG Services, through other studies. The service sponsor became my sponsor or main contact person for the *CyberSafe* research study. Her role as gatekeeper was to protect the rights and interests of potential participants. The gatekeeper had to vet me through a rigorous quality control process, ensuring that I was adequately trained in safeguarding and service protocols, in the case of any distressing information being shared during the research sessions. It was communicated to participants that confidentiality of information provided cannot always be guaranteed by researchers and can only be protected within the limitations of the law - i.e., it is possible for data to be subject to subpoena, freedom of information claim or mandated reporting by some professions. This process was communicated to the participants via the gatekeeper as is best practice (Carey, 2017).

Participants were informed of this information in the easy-to-read accessible information sheet and consent form. The St John of God Data Protection Impact Assessment (DPIA) statement identified that vulnerable people may be particularly concerned about the risks of identification or the disclosure of information.

3.8.2 Voluntary Participation and Informed Consent

Care was taken to ensure participants were not under any pressure to participate in the study and fully understood what was required of them. According to the Psychological Association of Ireland (2011), researchers should “seek willing and adequately informed participation from any person of diminished capacity to give informed consent” (p.8). The Services verbally communicated the contents of the Expression of Interest form and provided an accessible paper copy to interested participants. Emphasis was placed on voluntary participation welcoming the PwID to take part if desired and ensuring there was no expectation to do so. The support workers ensured that the participants fully understood all the documents. The accessible information and consent documents (see [Appendix A](#)) were designed in an easy-to-read format with simple text and pictures.

3.8.3 Confidentiality, Pseudonymity and Anonymity

Participant information was treated in full confidentiality and their association with the data was through the use of pseudonyms. When the students arrived for workshops held at my organisation, the Institute of Art, Design and Technology (IADT), they were given a piece a paper with their “*new IADT name*” on it for pseudonymity. These names were “*P1*” for participant 1, “*P2*” for participant 2 etc. During the whole session in IADT, students were only addressed by the new name (pseudonym). All recordings and notes taken referred to them with this new name. However, as the participants could withdraw from the study, it was required that their data could be identified and destroyed. Therefore, information was pseudonymised and could be linked without the need to keep all identifying characteristics with the data. This is in line with best practice recommendations for undertaking research studies using personal data under the Data Protection Act, 2018. In addition, as per DCU ethics guidelines, all electronic files and data were stored on a password protected DCU computer accessible only by the researcher and thesis supervisors.

3.9 Choice of Methods Summary

Table 11 A summary description of each of the research activities

Phases	Early Phase	Phase 1	Phase 1	Phase 2	Phase 3
Activities	SME Interviews	Support workers Survey	Empathy workshop & 1st co-design workshop	Co Design Workshops & lab sessions	Final Usability study
Participants	4 (Experts, Education specialists, Policymaker)	14	12 for co-design Workshop 1	9 for co-design Workshop 2	11 new participants
Measures	Qualitative questions	Single answer & free text	Qualitative questions	Camtasia recordings and researcher observation via audio recordings	Adapted SUS questionnaire
Analysis	Convergent parallel mixed method analysis	Thematic analysis	Thematic analysis	Thematic analysis and issue prioritisation analysis	Thematic analysis

As this thesis set out to examine an effective process of applying User-centred Design (UCD) methodology to the design of an educational cybersafety application for young adults with ID, the research activities conducted during this study were structured around a UCD approach (see Table 11 for a summary description of each of the research activities). The aim of the first phase was to explore the users' needs and define their challenges. The aim of the second phase was to co-design a solution with the users. The goal of the final phase was to validate the usability of the design solution with the intended users. The first iterations of the design system were informed by data gathered in the study's phase 1. The research methodologies conducted during this phase of the study consisted of a series of four semi-structured Subject Matter Expert (SME) interviews.

The analysis of these interviews informed the design of a survey on cybersafety with 14 support workers, results of which are detailed in Section 6.1. Other research activities were made up of an initial literature review, followed by a State-of-the-Art analysis of existing cybersafety resources for PwID. The second phase aimed to synthesise and refine potential design solutions from data collected from 12 PwID in empathy and co-design workshops, which addressed their needs specified. The third and final phase involved usability evaluation with 11 new participants, who had never seen the prototype. An extra phase of expert evaluation was not required as I was not evaluating the prototype as an eLearning resource as in the case of Design Based Research (DBR). I was testing CyberSafe's usability and engagement. Table 12 outlines the early phases of the user-centred research study completed e.g phase 1. See Table 13 for more details of activities during Phase 1, Phase 2 and Phase 3 stages of the study.

Table 12 Early phases of the user-centred research study completed

Phase schedule	Techniques	Objective	N	Data Type	Outcome
Phase 1: User Research and Requirements Desk research Completed 2018- 2020 Early Phase Proceeded with stakeholder data gathering and analysis Jan to April 2021	<ul style="list-style-type: none"> ▪ Literature review ▪ State of the Art 	<ul style="list-style-type: none"> ▪ Research existing applications and examine their approach with the user group 	N/A	<ul style="list-style-type: none"> ▪ Qualitative ▪ Analytical 	<ul style="list-style-type: none"> ▪ To refine research questions
	<ul style="list-style-type: none"> ▪ Interviews with a number of Specialists 	<ul style="list-style-type: none"> ▪ Identify issues users have with bullying and cyberbullying 	4	<ul style="list-style-type: none"> ▪ Qualitative 	<ul style="list-style-type: none"> ▪ To gather knowledge for prototype ▪ Answer RQ1
	<ul style="list-style-type: none"> ▪ Questionnaires 	<ul style="list-style-type: none"> ▪ Identify issues by instructors who work with the target user group 	14	<ul style="list-style-type: none"> ▪ Quantitative & Qualitative. ▪ Attitudinal 	<ul style="list-style-type: none"> ▪ Gather data to build a prototype

This researcher employed empathy, design and critique (i.e evaluation) workshops as a UX research method. Eight sessions in total were conducted with participants who were regular users of apps. The aim of these group workshops was to define what the users needed, design a solution together and highlight any usability or practical issues users may have come across when using the iteratively designed *CyberSafe* app. This was an opportunity in the first empathy workshop to discover how people used apps over a long period and to learn from their feedback. Audio recordings were collected during the early empathy and design workshop and final evaluation observations.

Table 13 Phase 1 (continued), phase 2 and phase 3 stages of the study.

Phase schedule	Techniques	Objective	N	Data Type	Outcome
Phase 1: (continued) User Research and Requirements Once approved, finalise Phase 1 data collection May 22	<ul style="list-style-type: none"> ▪ Group Workshops with SEN users 	<ul style="list-style-type: none"> ▪ Research issues with cybersafety ▪ Create low fidelity prototype solutions ▪ Discussion ▪ Understanding of user group. 	12	<ul style="list-style-type: none"> ▪ Qualitative ▪ Attitudinal 	<ul style="list-style-type: none"> ▪ Audio recordings ▪ Transcripts ▪ Paper-prototypes ▪ Design requirements ▪ Answer RQ2 ▪ Answer RQ3
	<ul style="list-style-type: none"> ▪ Persona and Scenario creation 	<ul style="list-style-type: none"> ▪ Draw up empathy maps for target user. ▪ Create representative personas of target users 	N/A	<ul style="list-style-type: none"> ▪ Qualitative 	<ul style="list-style-type: none"> ▪ Personas ▪ Empathy maps
Phase 2: Design, Prototyping and Test May to Nov/Dec 22	<ul style="list-style-type: none"> ▪ Prototyping 	<ul style="list-style-type: none"> ▪ Create a design that will fill the requirements. 	N/A	N/A	<ul style="list-style-type: none"> ▪ High-fidelity prototype
	<ul style="list-style-type: none"> ▪ Iteration 1 Usability Testing 	<ul style="list-style-type: none"> ▪ Receive feedback on 2 iterations of prototype. Make amendments based on feedback. 	9	<ul style="list-style-type: none"> ▪ Qualitative ▪ Behavioural 	<ul style="list-style-type: none"> ▪ Gather feedback ▪ Answer RQ4
Phase 3: Test Final Experiment Feb –April 23 Analyse data 2023 Write up 24/25	<ul style="list-style-type: none"> ▪ Adapted and accessible Usability and engagement tests. 	<ul style="list-style-type: none"> ▪ Validate and answer research questions. 	11	<ul style="list-style-type: none"> ▪ Qualitative ▪ Quantitative ▪ Behavioural 	<ul style="list-style-type: none"> ▪ Camtasia recordings ▪ Audio observational data ▪ Adapted System Usability scores ▪ Answer RQ4
	<ul style="list-style-type: none"> ▪ User testing 	<ul style="list-style-type: none"> ▪ Insights for future designs. 		<ul style="list-style-type: none"> ▪ Qualitative ▪ Attitudinal 	<ul style="list-style-type: none"> ▪ Answer RQ5

3.10 Conclusion

This chapter addressed methodological considerations and the research context setting for this *CyberSafe* study and provides theoretical discussion around these areas. The chapter discussed the research approach under the following headings:

- research objectives
- research questions
- data collection methods, underpinned by the philosophical paradigm and the assumptions I brought to the study
- types of data needed
- previous research on apps for people with ID including a State of the Art
- discussion of research methods chosen for this study
- ethical considerations

Chapter four (Methodology Part 2) will now describe in detail the specific tools designed for each of the four data collection points of the study, in terms of participant details and demographics, procedure and materials.

4. METHODOLOGY PART 2: OPERATIONALISATION

4.1 Introduction and Research Roadmap

This chapter describes in detail the specific research methods and tools utilised at each stage of the study. In all, there were 3 study phases commencing with an early stage study with key stakeholders and subsequent co-design and lab phases with PwIDs.

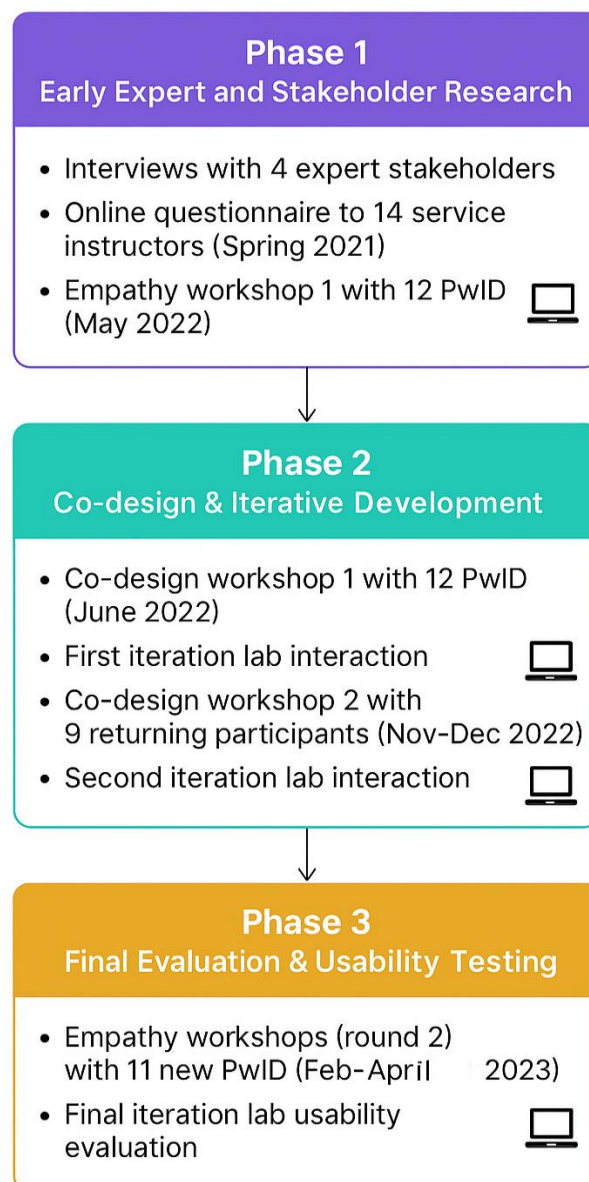


Figure 9 Phases of Research

Phase 1: Early Expert and Stakeholder research

Early expert and stakeholder research involved a preliminary study with four expert stakeholders in intellectual disability (service policy maker, PwID researcher, PwID advocate, senior instructor) to help inform the research and design of the prototype. This expert interview data then informed the design of an online questionnaire distributed to a larger user group of 14 stakeholders, who were instructors in the services in spring 2021. This larger group of 14 stakeholders (support workers) also worked with the target population, and their results were utilised to further refine user and design requirements for the proposed artefact. Informed by the stakeholder findings, the first empathy workshop was conducted with 12 PwID in May 2022. Empathy workshop groups were deemed suitable in this process, as the aims were twofold:

- To discover the participants' experience of using technology applications
- To research cybersafety in the user group including cyberbullying, using recordings of the participants' views and experience.

Phase 1 then informed the next stage of co-design activities i.e., Phase 2.

Phase 2: Two rounds of workshop activities were undertaken with 12 participants with ID in June 2022 and involved:

- First Co-design workshop i.e., Codesign Workshop 1
- First iteration Lab interaction

Research activities involving a second Iteration of the *CyberSafe* prototype were undertaken with 9 participants who were a subset of the original 12 in November /December 2022 and consisted of:

- Co-design Workshop 2
- Second iteration Lab interaction

Phase 3: This was the final research phase which involved the testing and evaluation of the *CyberSafe* prototype with 11 completely new participants in February/April 2023 and included:

- A fresh round of empathy workshops with PWID complementing data from the first round in May 2022
- Final iteration Lab usability evaluation

The various research activities are visualised in the roadmap Figure 11 below and will be described in more detail in the following sections of this chapter.

Cybersafe Roadmap

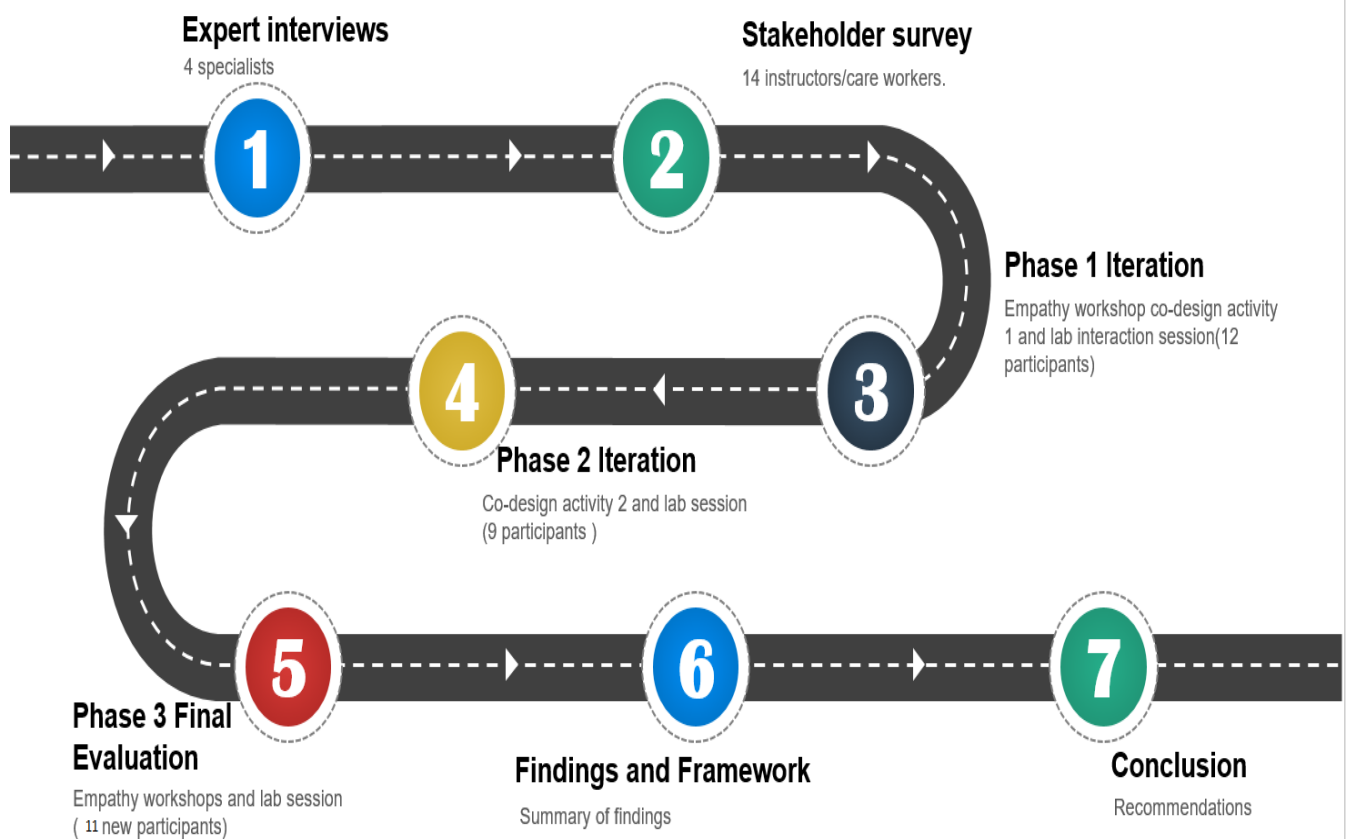


Figure 10 A roadmap of the primary research activities

4.2 Phase 1: Development of Research Tools



Figure 11 Phase 1

4.2.1 Interview with four stakeholders

A deductive approach was employed to formulate 10 interview questions for four expert stakeholder interviews, informed by the literature review. The initial semi-structured interview schedule (SSIS) comprised of ten open-ended questions, and were based on themes in the literature review. These themes included:

- Benefits of ID users being online,
- Obstacles facing ID users online,
- Risks ID users face online,
- Cybersafety awareness,
- Coping supports for cyberbullied victims and
- Future cybersafety educational interventions.

Questions in the interview were designed to elicit information around risks and benefits of internet use to answer RQ1 which was “what are the main themes for stakeholders around cybersafety for this user group”? The final interview protocol consisted of an opening statement, twelve questions, a closing statement and vital considerations for remote interviewing. The full interview can be viewed in [Appendix B](#). Upon interest being expressed, each individual was provided with an information document. From this, participants who expressed interest in participating were provided a range of dates and

times for the interview to be scheduled. After the interview, participants were provided with a debrief document. Given the depth of information being sourced from the interview, consideration was made towards priming participants with the questions before the interview. However, after careful consideration, I decided not to go down this route as doing so could lead to response bias and impact the flexibility of the interview (Robson and McCartan, 2017).

When drafting the interviewing schedule, consideration was given to getting to know the interviewee, their professional experience and present job role. An opening statement was crafted to discuss the purpose of the interview. More general questions were asked at first to allow the candidate to feel at ease. This then led to more specific questions. It was important in the interview process to stay focused on the purpose of the interview and to keep wording clear so that the interviewee could understand the meaning behind each question. Four face to face online interviews lasting thirty-to-thirty five minute were conducted and recorded with expert stakeholders' consent using Zoom. Only audio data was stored on the DCU Google password protected drive. Early results, from the analysis of the interview data, was used to inform the design of an online questionnaire distributed to a larger user group of 14 stakeholders, who work with the target population, to further refine user and design requirements. The results from this phase are presented in Chapter 6 Results.

4.2.2 Survey questions for 14 support workers

The online survey for 14 support workers consisted of both demographic and qualitative questions. Participants were based in adult educational training centres across the country. Participants were anonymous. The online survey consisted of 26 questions. The link to the full survey can be viewed in [Appendix C](#). The first three questions covered age, gender and number of years working with individuals with ID. The other 23 questions queried the professionals' views on how the internet had impacted the lives of the people with whom they work. Participants were asked about both positive and negative outcomes of internet use for this user group. Participants were asked about risks facing the people with whom they worked. These questions helped to address RQ1 "What are the main themes for stakeholders around cybersafety for this user group"? The support workers were

asked about the role of parents in PwID internet use and their views on educational resources needed. Participants were invited to take part through an email invitation, via contacts of the researcher in various service providers. Participants were asked to share the online survey with their fellow colleagues working in the area of ID. When completed, participants were given a debrief form. The survey was circulated among support workers in the support services. The survey received a total of 14 responses. Once responses were retrieved, data was analysed, the results are discussed in more detail in Chapter 6.

4.2.3 Empathy workshops with PwID

The next phase of research moved away from the service providers and involved conducting empathy workshops with the service users. An empathy workshop set of questions was drawn up to facilitate discussion about cybersafety. Initial demographics gathered data on age and gender and general use of internet on iPad, laptop or phone. The semi-structured interview schedule (SSIS) comprised 11 open-ended questions (see [Appendix D](#)) based on internet safety themes inspired by Borgström, Daneback and Molin (2019). The empathy workshop questions were carefully framed to avoid causing discomfort or embarrassment to participants. Questions were designed to elicit information around the use of social media apps, knowledge about cybersafety and privacy features and experience of cyberbullying to answer RQ2 which was “what key themes around cybersafety do young adults with ID report?”

Sample questions included:

- How often do you go on Facebook/WhatsApp, YouTube, Instagram or Snapchat?
- Can you describe the difference between a stranger and a real friend online?
- Do you know about privacy settings on Facebook/WhatsApp, Instagram or Snapchat?
- Have you ever seen someone being bullied online?

All materials provided to participants were accessible. Sample materials used in a previous study by this researcher (McDonnell *et al.*, 2020) included “Expression of Interest Form”, “Information Sheet Consent Form” and “Debrief Form”. The sample materials were adapted and redesigned in the same format for this present research *CyberSafe* study. Two

empathy workshops, with groups of six participants in each respectively, were carried out in May and June 2022. The participants were divided into two groups with six participants in each group. The workshops were recorded as participants voiced their thoughts and feelings. Recording audio allowed the researcher to pay more attention to the participants and focus on the activity rather than be distracted by taking notes. The empathy group workshops lasted thirty-five minutes and were structured according to a scripted procedure based on guidelines set by Goodman, Kuniavsky and Moed (2013). A five-minute introduction to the session was provided at the start. There was a discussion of apps, which the participants currently use. A discussion on all the 11 questions and ideas generated, which took place with all participants, lasted for 30 minutes. A pre-approved Dell computer recorded the audio of the empathy workshop sessions. No video was recorded. Once transcription was completed, all recordings were immediately deleted as per approved ethical guidelines. It was not necessary for the participants to write anything in the workshop, and therefore this method of using an empathy workshop was suitable for PWID.

4.3 More detailed Participant Data

Purposive sampling was utilised to recruit all participants to answer the research questions. This approach is a non-probability sampling strategy commonly used in qualitative research, where participants are intentionally selected based on specific characteristics relevant to the research question (Palinkas *et al.*, 2015). Unlike random sampling, which aims for representativeness, purposive sampling focuses on selecting information-rich cases that can offer deep insights into a particular phenomenon. This method is especially useful when studying hard-to-reach or specialised populations, such as PWID, where the researcher seeks participants who have first-hand experience or relevant knowledge. According to Patton (2002), purposive sampling supports depth over breadth, allowing the researcher to engage closely with participants and contexts to explore nuanced perspectives. While this method does not aim for generalisability in a statistical sense to answer the research questions, it enhances the credibility and relevance of qualitative research by ensuring alignment between participant characteristics and the aims of the study.

4.3.1 Expert Stakeholders

Professionals who work with young adults with ID were recruited by the researcher. These were contacts of the researcher through previous work completed on various studies for EU projects between 2016 and 2020. These professionals were emailed and invited to take part in the research, based on their experience and employment in the field of adults with intellectual disabilities. Four experts in the areas of ID were interviewed in January and February of 2021. These included a researcher who works directly with the target user group advising on cybersafety via the Independent Living Movement Ireland. Established in 1992, the Independent Living Movement Ireland was founded by and for people with disabilities, with the primary goal that persons with disabilities can live independently. This involves them freely making their own choices about their own lives and fully participating in Irish society as equal citizens. Other interviews were conducted with two instructional representatives from 2 different known national service providers and a policy maker in the area of online delivery for this user group. These participants were all female with an average age of 34 years.

4.3.2 Stakeholder Survey Participants

Purposive sampling (Palinkas *et al.*, 2015) was employed whereby professionals in the area of intellectual disability were contacted through the researchers' contacts to take part. 14 participants completed the survey (12 female and 2 male). The age range was 26-50 years with a mean age of 39 years. The mean number of years' experience working with PwID was 9 years.

4.3.3 Empathy workshops and lab PwID participants

Purposive sampling was employed. Participants were recruited based on their affiliation with a local service provider for PwID. Twelve participants with five to six staff were recruited via purposive sampling for each Phase of the study. The participants met the following exclusion criteria:

1. Adults (18 years and above) with an ID;

2. Sufficient verbal communication skills to express views while using the prototype and participating in the workshop group. Due to an absence of Speech and Language Therapy support, this requirement was necessary to avoid potential frustration should participants without such skills be unable to express themselves during the study.

13 PwID participated in the empathy and co-design workshop. They included 8 males and 5 females. The data of one 42 year old woman was excluded from the data analysis, as the specified target group was young adults aged 18-34 years. The mean age of the remaining 12 participants was 24 years and participants included a mix of both mild and moderate ID. All participants, with 2 supported workers in each group of 6 participants, attended an average thirty-five-minute empathy workshop with the researcher.

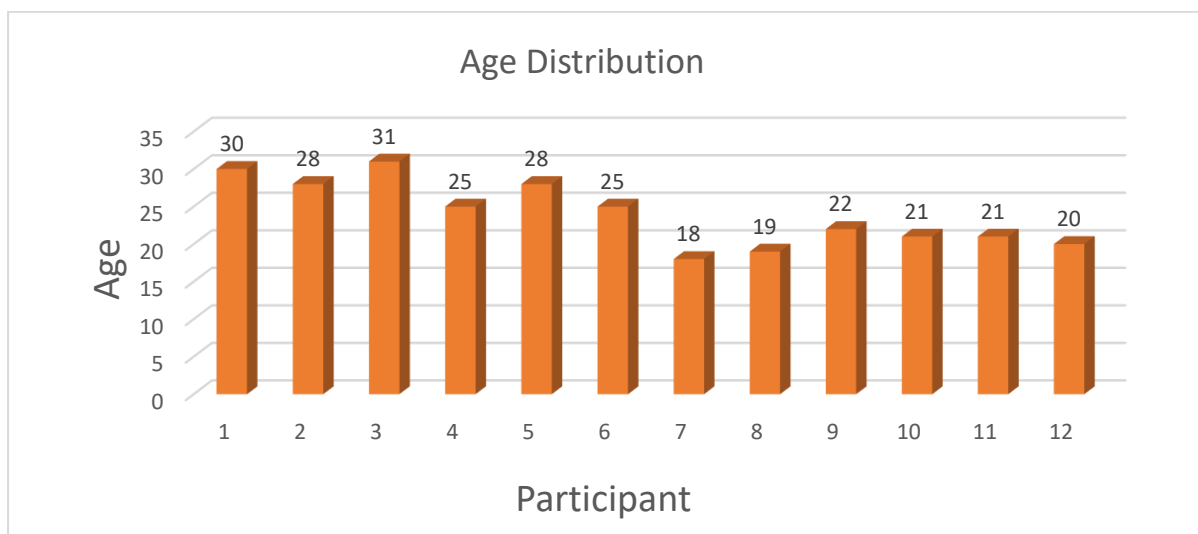


Figure 12 Age profile of 12 participants in Phase 1

Participants were treated with the ethical standards set by the Psychological Society of Ireland (PSI) and the British Psychological Society (BPS, 2021). For the final usability research and evaluation of the *CyberSafe* prototype, 11 new PwID were recruited and interviewed. They included 6 male and 5 female. The mean age was 23.2 years and participants were a mix of both mild and moderate ID.

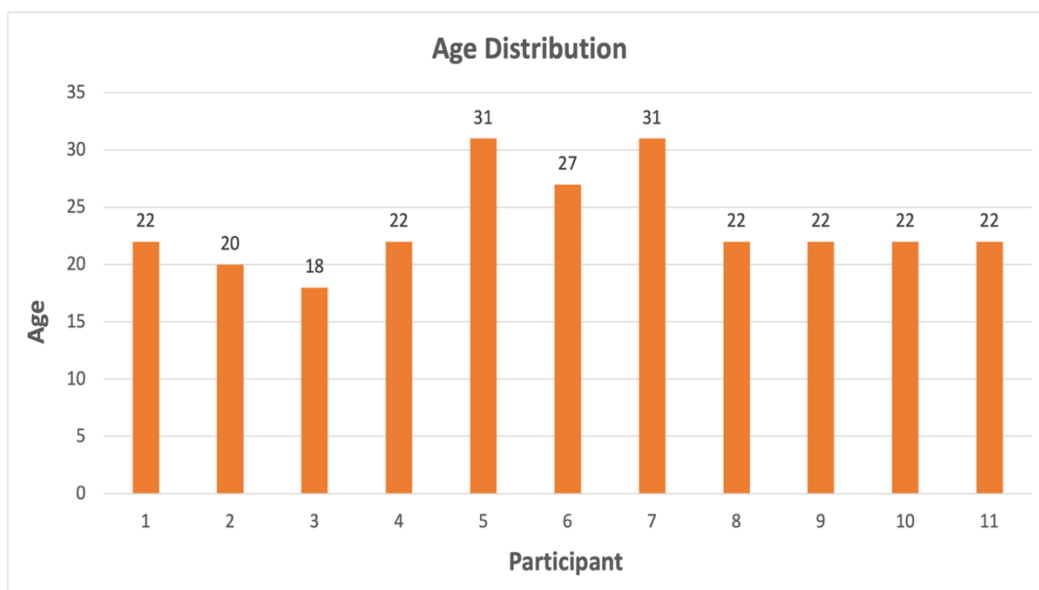


Figure 13 Age profile of 11 participants in Phase 3

Participants were based in Dublin, Ireland. There was no urban/ rural mix in the participant demographic, as given the ubiquitous nature of internet and phone app usage in Ireland, it was not deemed relevant.

In Phase 2, in the empathy and co-design workshops, data was collected from 12 PwID. They included 8 males and 4 females, a gender breakdown of 2:1 male to female. This is in line with general population figures.

11 new PwID were recruited and participated in the final two research and evaluation sessions in Phase 3. They included 6 male and 5 female, a more equal divide.

4.4 Co-Design Workshops

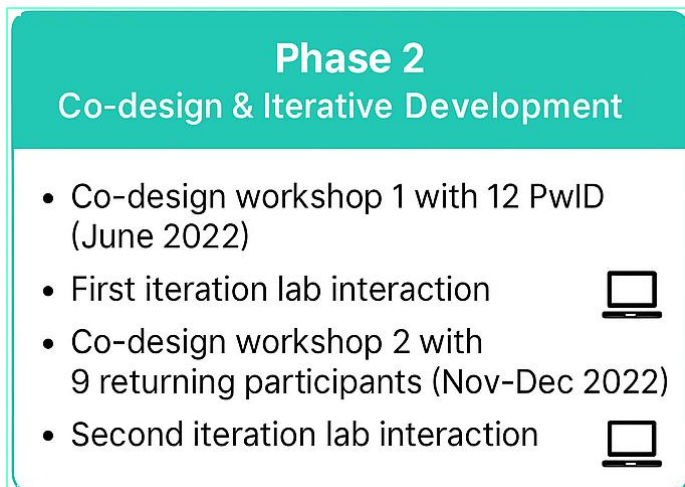


Figure 14 Phase 2

4.4.1 Co-design Workshop One

Co-design with PwID poses challenges for researchers and designers. “Participatory design holds great potential for the creation of inclusive technology but existing toolkits and resources to support co-design are not always accessible to designers and co-designers with disabilities” (Aswad *et al.*, 2022, p.1). For the *CyberSafe* study, there were two co-design workshops. The *CyberSafe* exercises used in the first co-design workshop were initially inspired by Sanders *et al.*'s (2010) work on participatory and co-design toolkits and then by Baylor *et al.* (2021) and Sitbon and Farhin (2017). The first codesign workshop experimented with user choices around quiz backgrounds, game characters and main menu icons.

Six co-design tasks were designed by this researcher and undertaken in this present *CyberSafe* workshop (see [Appendix E](#)). These included:

1. Game character Choice
2. Background Design patterns
3. Draw a game character
4. Reward graphic representation choices
5. Choose representational character in video
6. Icons vs Pictures for main menu items

Inspired by Sanders co-design framework (2010), the form of the initial six co-design tasks for *CyberSafe* workshop one involved making/drawing characters and participants, talking about their favourite colour schemes, choosing their favourite reward representational icon, and choosing between participant representation graphics and universal icons. Research (Buzzi *et al.*, 2016; Kwon and Lee, 2016) has shown games are an effective instructional aid in educating this user group. Moving /running games are very popular with young people generally, so the idea of a Maze game emerged. For one of the component activities in the TRUST module, the researcher was inspired to design a Maze game, which led the participant through a maze, making progress by making the right choice about accepting online friend requests in Facebook. The Maze game was also designed to get a better understanding of their current experience of friend requests on Facebook. For *CyberSafe*, the *purpose* of tasks 1 and 3 around the game characters was to probe the participants and prime them to immerse them in the Maze game. The other three tasks (design choices around colour schemes, reward representational icons, participant representation graphics and universal icons) were designed to act as a catalyst for the generation of ideas or design concepts for the future, for instance by creating and exploring scenarios. These scenarios were largely prompted from the four stakeholder interviews, who described the kind of challenges young adults face when engaging online with social media (see [Appendix E](#) for the first 3 tasks).

4.4.2 Co-design Workshop Two

The second co-design workshop sessions were conducted six months after the first co-design activity session. The objective was to gather input from the participants with intellectual disability (ID) on the design of four different components of the *CyberSafe* application privacy settings pages. The goal of the co-design activities was to create an application that best matched the needs and desires of the people who would use it. What follows is a summary of the method of the second co-design workshop with a total of nine participants that was conducted at the Institute of Art, Design and Technology (IADT) Nov 1 and 13th December 2022. In this second codesign workshop, the non-finito feature and early prototypes (Sitborn and Farhin, 2017) were applied. The prototype used was a version of

CyberSafe, which was tested by the PwID participants previously and modified in the first workshop, based on their feedback and preferences. Support workers were present during the co-design session, to ease the potential communication barriers. This co-design session resulted in some insights that could add to the existing body of research. Workshop two codesign tasks focused on *CyberSafe*'s Privacy module and in particular on Facebook's application security settings pages, as Facebook was identified in the empathy workshops as popular among participants. Lessons learned from this activity could be applied to other privacy information pages. The overall aim was to keep co-designing the interface and co-designing more suitable content to add to the six modules of the application (Cybersafety, Trust, Personal Info, Safety, Respect and Privacy).

4.4.2.1 CyberSafe Paper Prototyping

To recap, the first codesign workshop had experimented with user choices around quiz backgrounds, game characters and main menu icons. Moving on from co-design workshop one, after much thought, reading and reflection, the researcher decided to give the participants various laminated paper options of the *CyberSafe* interface. Part of the process of good design is to create paper prototypes, which are called a low-fidelity type of prototype testing, which makes changing aspects not as difficult. The idea of laminating the design elements was conceived from researching the literature of codesigning with people with ID (Bayor *et al.*, 2021; Sitborn and Farhin, 2017). As higher order cognitive skills are often required, such as abstraction, conceptualisation or creative thinking, through simplified task design, such as selection from options, the problem with abstraction/conceptualisation could be solved. The participants could easily handle the laminated elements that are sturdier than paper. Applying laminated elements created a dual learning approach: visual and kinesthetic. This would allow for a richer and more engaging learning experience. The more senses engaged, the better the learning and design experience is. In that way, they could decide for themselves what design they liked best.

4.4.2.2 CyberSafe Workshop Two "Method Story"

Method stories, which are background narratives that detail the context, application, and adjustment of a technique, help in making clear not just the actual outcome of a codesign

session (such as tangible artifacts or interfaces) but the story of how they came into being. Data from the recorded first Co-design workshop session was thematically analysed, in August 2022, to identify emerging and recurrent themes connected to young people's experiences with the topic of cybersafety. This analysis provided the direction for content creation for the next iteration of the *CyberSafe* instructional application, particularly in the areas of stranger danger, catfishing and privacy settings for various phone apps. Design choices in terms of character types, color choices, reward metaphor options and menu icons were clarified. Participants' scenarios during the previous empathy workshop sessions provided insight into the effects that cybersafety made on the personal and social life of PwID. While qualitative approaches were used in the analysis of the data from the first co-design workshops, they can also be less suitable when attempting to illuminate the benefits that young people directly experienced because of engagement (Benton and Johnson, 2015). Realising this, I decided to adopt a tool like the "method story" approach to provide a framework for coming up with concepts that are pertinent to the research objectives. I adopted the "method story" approach as an alternative approach in the second co-design workshop evaluation. Evolving from this method story approach, I switched my focus to "what designers actually do and feel when making their methods work" (Lee, 2014, p.1) rather than on the data, the interviews, or the observation notes. For HCI research on PwID to advance theoretically and methodologically, it must balance sensitivity to individual experience with rigour in articulating how design knowledge is produced, validated, and transferable. I realised that designing for PwID is not just a challenging area but it is also a test case for researchers and HCI theory itself. It exposes the limits of cognitive universalism and challenges assumptions about agency and participation. It demands methodological innovation that takes seriously the plurality of human actors (Bødker, 2006) which include both the participants and the researcher. I, the researcher was in this context, a situated, accountable participant rather than an external observer. Reflexive methodologies argue that researchers' assumptions, emotional labour, and ethical judgments are integral to the interaction being studied (Bardzell and Bardzell, 2013). In research with PwID, this reflexivity becomes unavoidable. Researchers often scaffold participation, interpret non-normative expressions, and make design decisions on participants' behalf. This challenges the boundary between "participant" and "designer" and supports a view of HCI practice as inherently relational and co-produced. I realised that I

had to innovate and come up with new approaches to illuminate the process and reveal insights and hence adopted the method story approach which focuses on "what designers actually do and feel when making their methods work" (Lee, 2014, p.1).

Through the second co-design process, I developed a sensitivity to the participants and their context. I had to continually pay attention to how the approach might somehow connect with and suit the actual context of PwID in order to make things succeed in practice. This section attempts to describe more fully the method story for the *CyberSafe* second co-design workshop two. Designing the second codesign workshop involved revisiting existing literature on co-design and specifically co-design with people with ID. The focus of the research was mainly how ID poses challenges for designers as stated previously, due to differences in their shared experiences. Miro is a great tool for brain storming, planning and designing using sticky notes. An ideas board based on a template by McKercher (2020) was created in Miro for co-design where all the steps of the process were documented (see Figure 16). The Co-design planning tool in Miro board (McKercher, 2020) was used to document the design and planning process of the codesign session. The next step in the story was to create a detailed session plan. Another Miro template was utilised which gave a general direction and aided the process by providing a list of crucial elements to consider (see Figure 17 for bigger graphic) e.g., Purpose, Scope, Success Criteria, Milestones, Actions, Users, Stakeholders, Constraints, Risks.

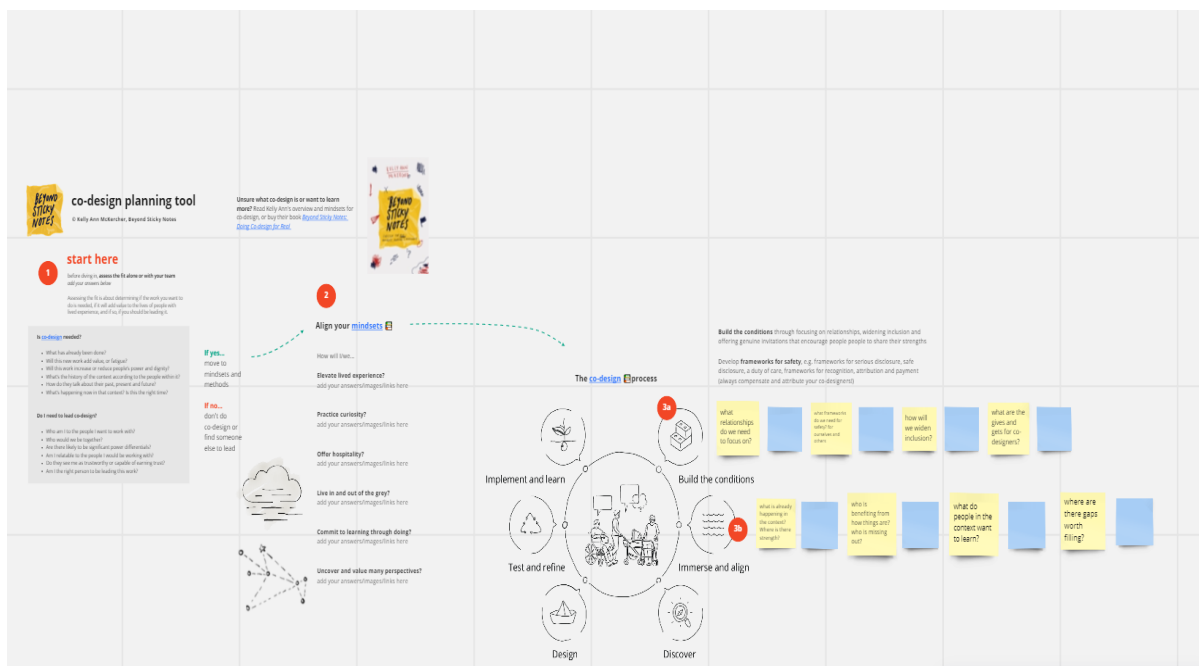


Figure 15 Co-design planning tool in Miro board

Creating a plan helped me gather my thoughts on all the aspects and the possible difficulties that might lie ahead. Completing the project plan based on a Miro template, edited to aid the design and plan for the codesign session, was a very satisfying exercise (see Figure 17). It helped to put structure on my thoughts, brainstorm and break the challenge down into achievable tasks. I felt that I was beginning to find a way to customise existing codesign techniques for users with ID. In this respect, as observed when researching the first codesign session, the general practice tends to be that researchers endeavour to learn from other researchers and designers. However, it is very rare that they are able to directly re-use a method or approach from other researchers and designers. Each codesign activity demanded a customised approach, but still required my creativity to make further adjustments according to the specific goals and participants of the study. Combining the use of tools like Miro, Figma and templates such as the one by McKercher (2020) made what initially seemed like a huge challenge, feasible and the steps to tackle the challenge began to take shape in my mind. Next, a detailed instruction sheet was prepared to aid the codesign session (see Figure 18) which involved four tasks for the participants with precise instructions. A Miro board template was utilised to create the Task sheet.

Once the high-fidelity prototypes were completed, the next step was to think about how to create the right conditions for the codesign session. While going through the research focusing on these above-mentioned concepts, I thought about and outlined potential problems on the *Co-design planning tool in Miro board* (see Figure 16). These are the questions posed by the planning tool and the answers the researcher considered, concerning the optimal codesign session conditions. See [Appendix F](#) for use of this planning approach, questions asked and answered in advance of the Co-design session. The *Co-design planning tool in Miro board* posed questions and what follows next are the answers to these questions together with the researcher thoughts, considered through the lenses of the study's underlying theoretical frameworks concerning the optimal codesign session conditions.

What frameworks are needed for safety for all involved?

Answer: The Codesign session will be organised abiding by the ethical and safety framework within SJOG, DCU and IADT.

Ethics functions as a bridge between the integrated framework of Social Shaping of Technology and Social Justice Theory oriented inclusive practice. While SST explains how educational technologies embed social values and power relations (MacKenzie & Wajcman, 1999), social justice theory provides criteria for evaluating equity, recognition, and participation (Rawls, 1971; Bell, 2016). Ethics addresses the question of what ought to be done in the design, implementation, and governance of digital technologies for PwID. Ethics ensures that technological flexibility and personalisation do not reproduce deficit-based assumptions, exclusion, or surveillance practices, but instead support dignity, agency, and meaningful participation (Carr, 2014).

How do people in the context want to engage and learn?

Answer: A visual and kinesthetic approach will be used so the engagement is in that context

Visual and kinaesthetic approaches occupy a key capability-enabling position by supporting meaningful digital participation for PwID. From a capability perspective, visual, embodied, and hands-on supports the conversion of technological access into practical skills, confidence, and digital agency (Sen, 1999). Within the Social Model of Disability, these approaches address socially produced barriers embedded in text-heavy and abstract digital environments, reframing accessibility as a design responsibility. Socio-technical and HCI research shows that multimodal and embodied interfaces improve usability by aligning with diverse cognitive strengths (Norman, 1999; Hutchby, 2001). Participatory design research further demonstrates that such approaches often emerge directly from co-design with PwID (Bayor et al., 2021; Safari et al., 2024).

Where are the gaps worth filling?

Answer: Codesign methods frequently draw upon exactly those skills that people living with cognitive or sensory impairments have problems with. Higher order cognitive skills are often required, such as abstraction, conceptualisation or creative thinking. Through simplified task design (tactile engagement with options) the problem with abstraction/conceptualisation may be solved.

From a Social Shaping of Technology perspective, exclusion in codesign is consequential because technological outcomes reflect whose interpretations and interests are meaningfully translated into design (Bijker, Hughes and Pinch, 1987; MacKenzie and Wajcman, 1999). When codesign privileges abstraction and symbolic communication, it reinforces dominant cognitive norms, marginalising people with cognitive or sensory impairments and limiting their interpretive power (Bijker, 1995; Winner, 1980). Simplified task design using tactile and material engagement reconfigures participation by enabling embodied, sensory interaction and reducing reliance on abstraction. Such artefacts function as boundary objects that support participation across cognitive differences (Star and Griesemer, 1989). From a social justice perspective, these methods promote fairness (Rawls, 1971) and expand real participatory capabilities, enabling substantive inclusion rather than just access alone (Sen, 1999).

What is already happening in the context? Where is their strength?

Answer: The session will focus on a participatory approach. The aim is to facilitate moving people from participants to active design partners.

Grounded in Participatory Action Research (PAR) and co-design traditions, this shift moves beyond consultation towards shared decision-making and the redistribution of power in knowledge production (Edler, 2020). From a capability perspective, active design partnership enhances individual agency and expands real freedoms by enabling PwID to influence technologies that shape their everyday digital lives (Sen, 1999). This repositioning is further supported by disability rights frameworks, which assert that meaningful participation in decision-making processes is a fundamental human right, encapsulated in the principle of Nothing About Us Without Us (Charlton, 1998; United Nations, 2006). From an SST standpoint, involving PwID as design partners challenges dominant power relations embedded within technological systems and disrupts ableist assumptions about competence, thereby contributing to more equitable and socially responsive digital outcomes (MacKenzie and Wajcman, 1999; Orlikowski, 2000).

What relationships do we need to focus on?

Answer: We need to design the tasks in a way that we work together and codesigners' needs and abilities are taken into consideration, thus strengthening relationships through social support and trust.

SST theory emphasises that technology use is produced through social relations among users, caregivers, designers, and institutions, embedding power and values that shape access, interpretation, and regulation, with direct implications for digital inclusion and justice (MacKenzie and Wajcman, 1999; Orlikowski, 2000). From a digital inequality perspective, supportive relationships are critical in mediating access to devices, skills development, and the ability to translate digital engagement into meaningful offline outcomes, particularly for PwID who often rely on proxies for digital participation (Van Dijk, 2005; Brereton et al., 2015; Wilson *et al.*, 2016). The Capability Approach further conceptualises capabilities as inherently relational, developed through social support, trust, and opportunities for guided autonomy rather than through individual skill acquisition alone (Sen, 1999). Accordingly, relationships are understood within this framework as dynamic and ethical forces that can either reinforce exclusion or enable empowerment, inclusion, and digital justice.

How will we widen inclusion?

Answer: Designing with people is about what matters to people with lived experience and decision-makers.

In the context of SST and SJT theories, widening inclusion involves engaging PwID, caregivers, and institutional decision-makers in shared responsibility for inclusive digital design (Brereton *et al.*, 2015; Wilson *et al.*, 2016). This will ensure that the priorities and experiences of PwID inform both the content and governance of digital safety education

What are the gives and gets for co-designers?

Answer: The co-designers require support and encouragement to adopt new ways of being and doing, learn from others, and have their voices heard. To support that, the facilitator needs to coach. Everyone has something to teach and something to learn. The tasks need to be finely tuned to then draw conclusions by analysing the session's positives and negatives

Co-design workshops with PwID require facilitation to function as a core methodological practice. Inclusive participatory design research shows that PwID are often positioned as consultees, necessitating structured facilitation to enable equitable contribution and shared decision-making (Seale et al., 2017). Methodologically, facilitators need to adopt coaching practices such as scaffolding communication and legitimising lived experience as design knowledge. They need to foster confidence, and mediate power relations between PwID and professional stakeholders (Sanders and Stappers, 2008; Safari *et al.*, 2024). In social justice terms, participatory methods must be structured to avoid systematic disadvantage (Rawls, 1971). The capability approach further frames facilitation as expanding participants' real opportunities to participate meaningfully (Sen, 1999). Such facilitation enables PwID to exercise genuine agency in shaping technological outcomes, from the perspective of SST, thereby supporting a substantively inclusive and socially just design processes (Donetto et al., 2015).



Figure 16 Miro Project Plan

Step by step guide

Go Design Session 🤖 Tasks ✍️

Duration: 30 mins for each session

4 tasks

9 participants in total

3 support staff

2 screens from the app will be displayed on the wall prior participants entering the room.

The screens will be the home page, then FB privacy settings in order the guide the participants where they are in the application. Laminated screens will be hand out to the participants with cF logo, home button and back button.

3 sets of menu button sizes with shape and size variants will be handed out to the users to place and select.

Instruction: You have 3 sets of menu buttons. Please place each of the sets onto your screen. Try all of them and decide which one you prefer.

Researcher will take a photo of the preferred logos.

3 sets of bread crumbs with colour and fill variants will be handed out to the users to place and select.

Instruction: Please place the logos onto your screen. Try all of them and decide which one you prefer.

4 sets of video screen versions will be handed out to the users to place and select.

Instruction: Please place the video screens onto your screen. Try all of them and decide which one you prefer.

Participants can design a screen using all the parts provided in the previous 3 exercise.

Instruction: Please make a screen with the buttons, bread crumbs and video screens.

Researcher will collate the data and determine the design preference of users.

Co-design session	
Who	9 participants, 1 organiser
Where	JADT Campus Carriglea building
What	cyberSAFE project

Set up	
Who	Researcher
Duration	2 mins
What	Setting up the 4 tasks

Task 1 Menu button selection	
Who	9 participants, 2 facilitators
Duration	5 mins
What	Privacy set up logo selection

Task 2 Bread crumb selection	
Who	9 participants, 2 facilitators
Duration	5 mins
What	Bread-crum variation selection

Task 3 Video screen selection	
Who	9 participants, 2 facilitators
Duration	5 mins
What	Video screen variation selection

Task 4 Free flow screen arrangement	
Who	69participants, 2 facilitators
Duration	5 mins
What	Free flow screen arrangement

New table

Conclusion Happy End	
Who	Researcher
Duration	30 mins
What	Design preference

Figure 17 Four tasks with precise instructions

Paper and Figma Tools

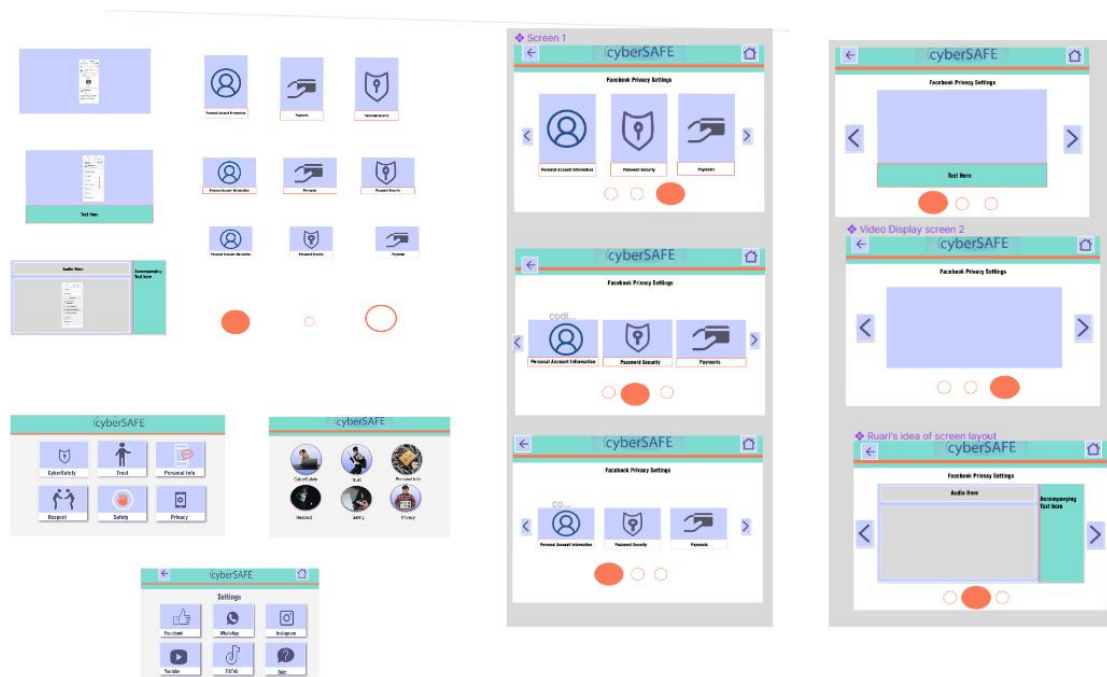


Figure 18 Figma, high fidelity prototype screens with different size menu button, breadcrumb buttons (orange and white)

Three different size menu item boxes, breadcrumb icons to track progress, and video screens were created in the digital prototype and printed (see Figure 19). Participants were asked to place the various items on their blank laminated screen, experiment with where to place them and to choose their favourite ones. At this stage, it was unclear if the user group could think abstractly to make decisions on the design. Even if the users could not communicate why they had picked a particular interface element, from the previous first co-design workshop, it was clear that they could communicate what they liked and did not like i.e., their preferences. As the *CyberSafe* app was designed specifically for this user group, they now could have more input into how they wanted it to look while working to their strengths (Bayor *et al.*, 2021).

Once the paper prototyping was completed, high fidelity prototyping could commence. A high-fidelity prototype is a simulation of the application. Visual design details

and real content show the look and feel of the end product. Elements of the prototype such as icons, breadcrumbs, video screens and along with the existing *CyberSafe* home screen were created, printed and laminated. Breadcrumbs are an interface design element used to highlight the users' navigation trail through the pages of the application (see Figure 20 for samples tested).

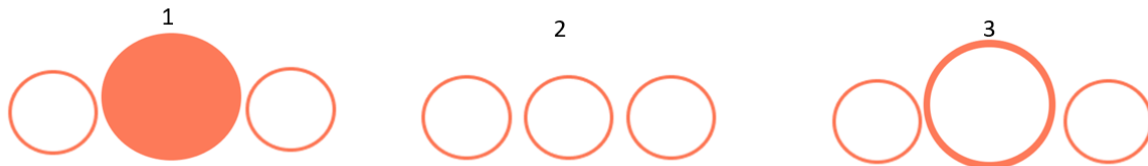


Figure 19 Three versions of breadcrumbs

The user-centred design process of designing the early *CyberSafe* screens allowed the users have their say in its design. The user-centred design approach could not be evaluated without designing and developing an early application prototype.

4.5 Lab sessions

4.5.1 Lab Session one

Informed by the findings from codesign workshop 1, an initial educational application called *CyberSafe* was designed and prototyped in Adobe XD with the assistance of a graduate designer. For testing, robust interactivity and functionality provided a more realistic user experience. At this stage, the original 12 participants were invited back to a lab session in IADT in May and June 2022. The aim was for them to interact with the proposed early screens of the *CyberSafe* application. Two of the six modules were populated with a video on cyberbullying, called “What is Cyberbullying”, a maze game element (exploring who to trust online) and a quiz about online safety. For the lab session, an accessible Usability Task List was developed to guide participants through a number of tasks intended to test the prototype (see [Appendix G](#)). Accordingly, the task list was designed to give as much guidance as possible by using screenshots with circles highlighting relevant areas where necessary.

Desktop computers with mice and headphones were provided to participants. The computers were preset with the second iteration screens of *CyberSafe* and headphones were provided for participants. No identifying characteristics of participants were recorded. Participants engaged in 3 contextual activities: viewing a video on cyberbullying, playing the maze game with the characters and doing a short quiz. Through these activities, participants used some of the design features of the interface, giving the researcher an opportunity to observe usability challenges. Camtasia screen recording software was used to document user interactions, as they performed the three tasks using the early prototype application. This enabled the researcher to perform detailed post-session analysis of user pathways, hesitations and errors. Camtasia allowed for repeated review of interactions, thus enhancing the reliability of observational findings and supporting triangulation with field notes and think-aloud data (Lazar, Feng and Hochheiser, 2017). As the ethical approval granted for *CyberSafe* did not allow for other observers in the workshops, the Camtasia recordings provided some objective data. Observations by the researcher in the lab were also recorded. The self-reported usability data was collected from the participants in the lab sessions via the adapted System Usability scale (SUS) self-reported questionnaire. This post lab accessible adapted system usability scale questionnaire was designed to gather participants' views on usability and engagement relating to the 3 features tested i.e., play a video, play the maze game and answer a quiz. See [Appendix H](#) for questions asked in the post lab accessible questionnaire. Interaction with an early stage prototype allowed for in depth examination of the research question 4: *What usability, satisfaction and engagement issues did this user group report when using the prototype, which was developed using a UCD methodology?*

In particular, this research question was broken down into 3 subcomponents:

- a. What usability interface problems do users encounter using the application?
- b. Do users engage with the application?
- c. Are users satisfied with the application?

4.5.2 Lab Session two

Feedback from the first usability lab was analysed and changes were made to the prototype to address the needs of the users and test out the findings. The second iteration of the CyberSafe prototype was updated using feedback from the first round of testing and the co-design workshop. A second usability testing lab was carried out in November and December 2022, following a similar procedure to Lab 1. Nine participants, drawn from the original group of twelve, took part in this round.

Participants were asked to complete five tasks using the prototype: play the Cyberstalking video, watch the YouTube privacy settings videos on blocking and reporting, complete the Cyberstalking quiz, and play the Coin Game. To support accessibility, a revised Usability Task List was created to guide participants through each task. After the session, participants completed an accessible, adapted System Usability Scale (SUS) questionnaire. This questionnaire gathered feedback on usability and engagement for each of the five features tested. The full set of post-lab questionnaire questions can be found in [Appendix I](#).

4.5.3 Final lab session three

Phase 3
Final Evaluation & Usability Testing


- Empathy workshops (round 2) with 11 new PwID (Feb-April 2023)
- Final iteration lab usability evaluation 

Figure 20 Phase 3

During the previous second phase lab usability testing, the participants and support workers suggested refinements, which fed into the planning of the final round of usability testing sessions implementing the following improvements in the *CyberSafe* prototype:

- Privacy videos broken down into steps
- Additional interactivity was added to privacy settings video (Snapchat and how to avoid Catfishing)
- Because games were so popular, a friend and fake game was added with animated lottie file badge icons used for successful outcomes for participants. A lottie is a JSON-based file format used for high-quality animations. It is designed for cross-platform use, allowing seamless integration into web and mobile platforms. Its advantages include small file size, infinite scalability and ease of implementation by developers.

The third and final lab usability sessions were held in February and April 2023 with 11 new participants. The rationale here in recruiting 11 new participants was to avoid the learning effect (Salkind, 2010) as the previous participants had already interacted with the prototype twice. The procedure was the same as followed in the earlier lab sessions. A third and final accessible Usability Task List was developed to guide 11 new participants through five new tasks intended to test the prototype (see [Appendix J](#)) e.g., play the Catfishing video, do the Snapchat interactive exercise and play the Friend or Fake game, play the Coin game, watch the WhatsApp video. A post lab accessible questionnaire was designed to gather participants' views on usability and engagement relating to features tested.

4.6 Data Consistency and Validation

In the context of this *CyberSafe* study, there was a single coder involved and the goal was to evaluate the extent of intracoder (within a single coder) reliability (IRC). In this case, the importance is placed on the extent of consistency with how the same researcher codes data at multiple time points (Cofie, Braund and Dalgarno, 2022). As Conner and Joffe (2022) describe, if the same researcher returns to the data at another time, it should be possible to assess the extent of consistency in the coding process, thereby promoting researcher reflexivity. Clarke and Braun (2019) do not advocate intercoder reliability. In this *CyberSafe* study, themes and subthemes were defined from the codes, located and colour coded using a fresh script. Braun and Clarke's (2019) checklist was employed to ensure valid

thematic analysis. Thematic maps were generated, and results were written up. In this present study, the observational method of usability evaluation focused on usability and engagement of participants during their interaction with the prototype during phase 1 and 2 stage iteration testing and during the final evaluation phase. Thematic analysis was conducted on the data collected during the observations, which included screen capture Camtasia recordings and the researcher's audio recorded comments from the users as they interacted with the application. An adapted accessible user experience questionnaire was created with smileometers for feedback to triangulate with Camtasia recordings and researcher observations audio recordings (see sample at [Appendix I](#)).

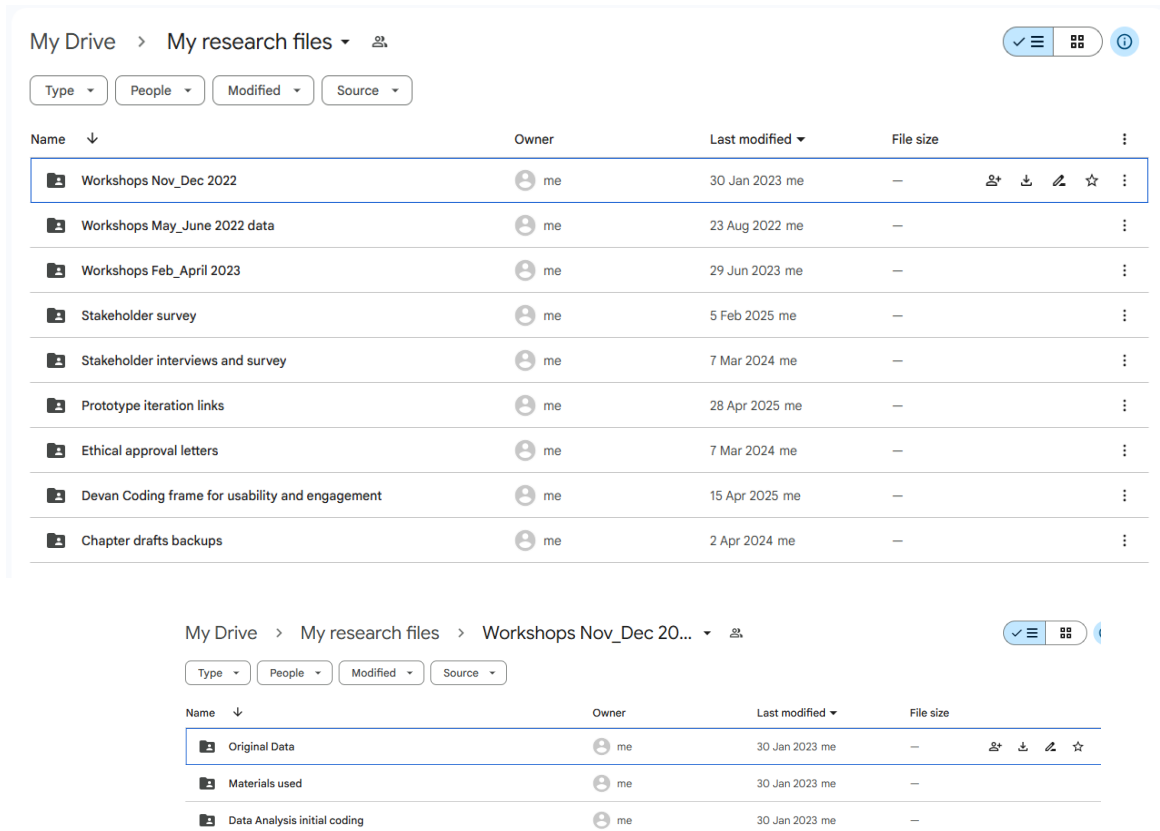
Qualitative researchers have proposed alternative quality criteria that substitute the typical standards used in evaluating quantitative research (Bauer *et al.*, 2000). These include transparent reporting of the analytical procedures, producing "*thick description*" with plentiful samples of raw data, triangulation between numerous data sources and attention to "*deviant*" cases (Conner and Joffe, 2022, p.4). In the reporting of the *CyberSafe* study results, thick descriptions were used with plentiful quotations from participants and "*deviant*" cases are reported.

To "*demonstrate transparent reporting of the analytical procedures*" (Conner and Joffe, 2022, p.4), this next paragraph describes the measures taken to ensure that the data collected in the lab sessions was valid and consistent. Macedo and Trevisan (2013) developed an evaluation method to measure usability and interaction of children with Down's syndrome, which demonstrated reliability with a Cohen's kappa of 64% as well as inter rater agreement. This method informed *CyberSafe's* observational data analysis and data coding. These codes and descriptions are available to view in [Appendix N](#). A similar method was employed by Hoe, Hisham and Muda (2015), also with Down syndrome participants, to measure usability and engagement and was found to be successful. User data was recorded using Camtasia screen recording software. Participant keystrokes were described and analysed for similar codes using deductive thematic analysis inspired by the previously mentioned coding frame from the literature (Macedo and Trevisan, 2013). The researcher's verbal observations during the labs were recorded, coded and guided by similar coded themes taken from the literature to measure usability and engagement. Frequency scores of certain occurrences (e.g errors) from the Camtasia recordings were noted. Thus,

the deductive approach was used when analysing data collected during this observational process. This method was appropriate in identifying sub-themes within the data under examination. The themes were colour-coded and identified within the data.

4.7 The Coding Process

The coding process of data collected from four separate data collection points was completed over the period from spring 2022 to summer 2023. There was sufficient time between each data collection point to analyse, code the data, and apply the relevant changes and refinements to the *CyberSafe* prototype. This schedule was carefully planned. Each data coding session required concentrated effort and organisation. Data was carefully sorted into folders and subfolders in Google Drive (see layout in Figure 22) to reflect each step in the data collection and analysis process. Audio recording(s) of participants' contributions and researcher observations were collected during the empathy workshops, co-design workshops and lab sessions. Camtasia screen recordings of participants' interaction with *CyberSafe* were made during lab sessions.



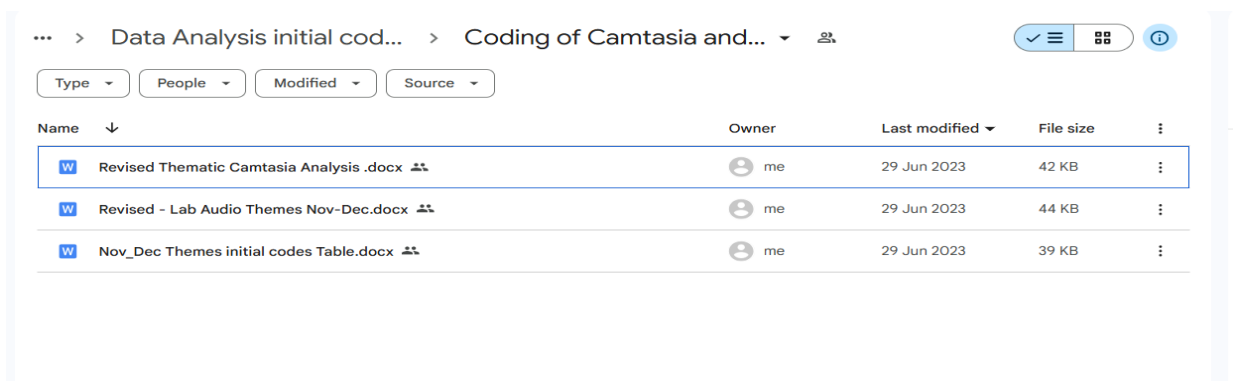


Figure 21 Google Drive folder layout

The codes were colour-coded and identified within the data. Sub-themes were identified and then primary themes upon further analysis of the data. As an example of how this was achieved, the following 3 sections describe the process followed for coding and analysing the data from:

1. the empathy workshops
2. the codesign workshop activity 1
3. the first lab sessions

4.7.1 Empathy Workshops Data Analysis approach

Codes based on the Empathy Workshop group questions were used to analyse the workshop group data. These were refined in an inductive manner to generate final themes, which reflect the participants' views on cybersafety. The inductive approach to thematic analysis was allied to the voices of PwID in the empathy workshop. An inductive approach to thematic analysis means that the themes are identified, and are constructed from the data. In this manner, themes can change and grow depending on what the data reveals. This kind of analysis allows rich data to be collected and is therefore suitable to apply to data gathered from focus groups (Maguire and Delahunt, 2017). Clarke and Braun (2019) outline a 6-step process for thematic analysis. Familiarising oneself with the data several times: conducting and transcribing the interviews reviewing the script, generating initial codes and initial themes for data, refining themes and report writing. Following their recommendation, a script wall (cutting out quotes and placing them on a wall to view them) was created to break up and ease coding and as they advised, reference was made back to the original data. Quotes

are referenced in the results first by group number and quote number in the quote diary document. Participants are identified in the quote section as P1, P2 all the way up to P6, as there are 6 participants in each group. Staff carer /support workers in each group are identified by Group number, carer number e.g., G2C1 identifies carer 1 from group 2. Carers is a term cited in the literature to cover parents, guardians and in some cases residential staff carers or support workers. The PWID in this study sometime refer to their minders as a 'carer' or 'support worker' or 'key worker'. In this study, the only carers involved were support workers. The use of "R" represented the researcher.

Step one: familiarisation with the data

The 'familiarisation' phase is practised in many forms of qualitative analysis. This involves the researcher reading and re-reading the transcripts in order to become very familiar with the data. This is necessary for the researcher to be able to identify any relevant information that may be appropriate to the research question as for example in RQ2 which is "what key issues around cybersafety do young adults with ID report"? At this stage, I started familiarising myself with the data by listening to each Empathy workshop recording once. Then I transcribed that particular audio file. This first time listening to each focus group audio files required concentrated listening. I manually transcribed each empathy workshop session immediately after this concentrated listening exercise. 'Manual transcription of data can be a very useful activity for the researcher in this regard, and can greatly facilitate a deep immersion into the data' (Byrne, 2021, p1398) I then read each transcript several times. When complete, I made a few notes of any initial trends observable in the data and placed potentially interesting sections I found in the quote diary for that transcript. See [Appendix K](#) for quote diaries from these workshops. It will be seen later that some of these initial quotes would go on to inform the interpretation of the finalised thematic map.

Phase two: generating initial codes

"Codes are the fundamental building blocks of what will later become themes" (Byrne, 2021, p1399). These building blocks or pieces of information may be of relevance to research

question 2, which is “what key issues around cybersafety do young adults with ID report”? I followed Byrne’s recommendation to work systematically through the entire dataset, attending to each code with equal consideration, and identifying aspects of data items that were interesting and may be significant in developing themes.

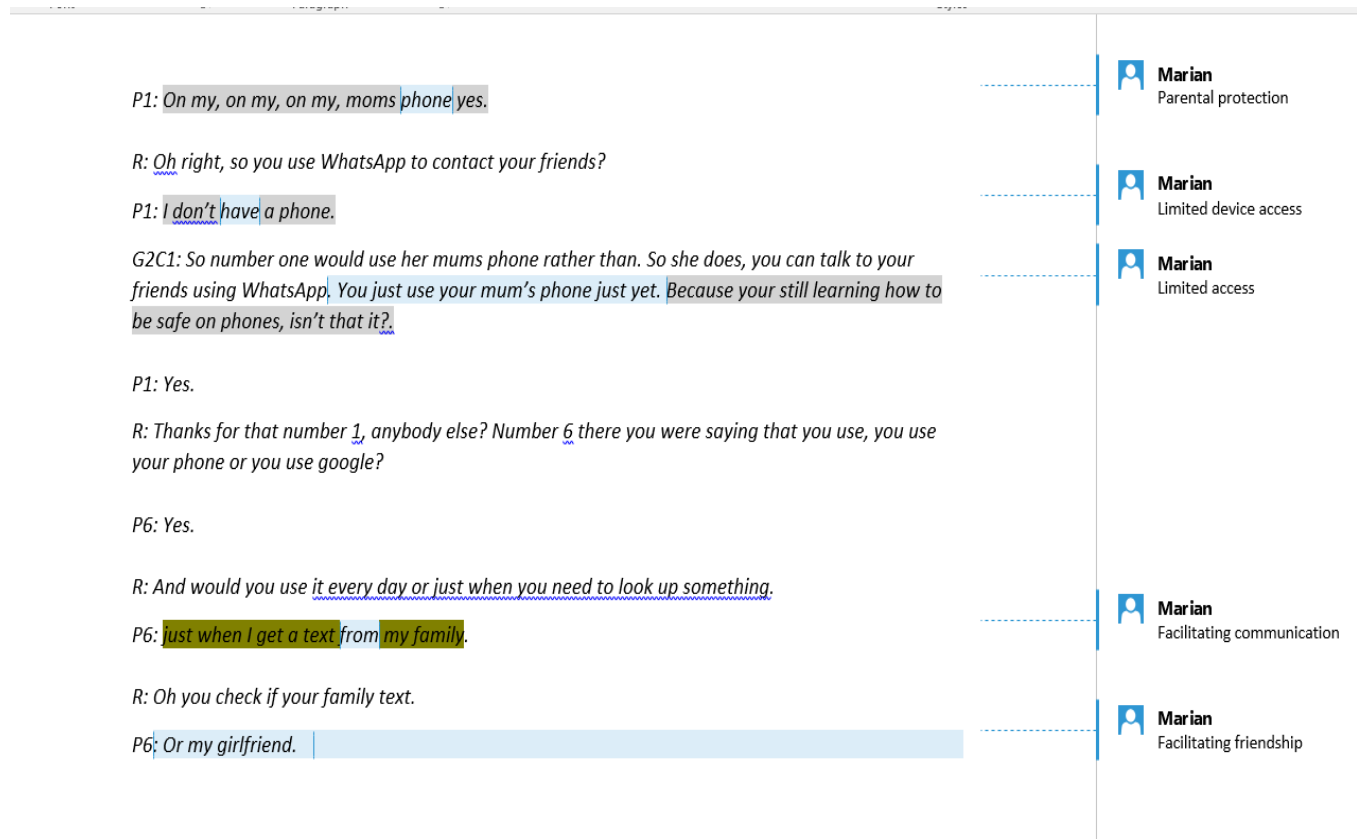


Figure 22 Coding excerpt

A brief excerpt of the preliminary coding process of the first empathy workshops transcript is presented in Figure 23. This first version of coding was completed using the ‘Comments’ function in Microsoft Word version 2016. This allowed codes to be noted in the side margin, while also highlighting the area of text assigned to each respective code.

Step three: generating themes

I began generating themes when all the relevant pieces of data had been coded. “The focus shifts from the interpretation of individual data items within the dataset, to the interpretation of aggregated meaning and meaningfulness across the dataset” (Byrne, 2021, p.1403). I reviewed the coded data to see how various codes could be combined to create some shared meaning. The aim was to create themes or sub-themes. Estimating the importance or relevance of a theme is not dependent upon the number of codes or data

items that inform a particular theme. What is important is that the pattern of codes and data items communicates something meaningful that helps answer the research question (Braun and Clarke, 2019). The coded transcripts for both empathy workshops are uploaded to the relevant Google drive. Steps 4-6 were then followed: Reviewing, defining potential themes and writing report.

4.7.2 Co-Design Workshop 1 data analysis approach

Data Familiarisation

In Phase 2, two initial co-design workshops were recorded, creating the raw data script used to conduct the thematic analysis. The first stage involved transcription, allowing me to familiarise myself with the data. The familiarisation phase involved me reading and re-reading the transcripts in order to become intimately familiar with the data, before commencing the generating codes phase.

Generating Codes

Having read the Co-design workshop transcriptions from group one and group two multiple times, I began the next step of manually coding the raw data. This involved gathering initial codes and placing them beside the corresponding data in the word document containing the interview transcript. *The initial codes included knowledge, lack of knowledge, separation, likes, suggestions, fun, preferences, carer comment, safeguarding, clarification and focus attention.* For example, the code fun was used in correspondence to one of the participants expressing the emotion of fun while taking part in an activity or concerning a question. Codes identify a feature of the data that appears important to note and refer to the raw data that can be assessed in a meaningful way to answer the research question (Boyatzis, 1998). After generating the initial codes, the data correlated with the codes were reread multiple times to see if any further comments could be made. These comments pointed out potential problems with the initial codes, which I further investigated. These comments were typed and attached to the codes on the script to be looked at later if needed. Comments included presenting a different code, which may be more suitable to the corresponding section, or suggesting there was overlap or inconsistency with the coding. This stage involves moving back and forth between the data set, the codes, and the data analysis, which takes

time but is vital in assisting the next step. During the coding process, I remembered to capture interpretations of the data while still relating it to the research question. Terry *et al.* (2017) state that coding allows the researcher to develop insight and provide a foundation for the analysis. After gathering all the coded data, a rough list was made with the new codes and initial code count frequency was conducted for co-design activity one, group one and group two. The final codes were significantly more than the original ones identified, and consisted of *error, navigation, trial and error, likes, findability, learnability, suggestions, changes to apply, frustration, fun, preferences, carer comment, safeguarding, vulnerability, implicit, explicit, lack of knowledge, dissonance, clarification, focus attention, elaborating, reading and writing, hesitant, reassurance, laptop, iPad, and iPhone.*

Searching for Themes

Once the initial codes were discussed and changed, it allowed me to move on to searching for themes. In this case, the researcher is a builder, constructing a truth from the data. Data is constructed in a context and is valid if we have a clear research question and follow a rigorous process. Braun and Clarke (2019) describe gathering and constructing themes as an active process of pattern formation and identification. Developing themes involves examining the codes and combining these codes by identifying a central organising concept into a more prominent pattern relating to the research question (Clarke, Braun and Hayfield, 2015). Braun and Clarke (2006) state the importance of each code needing its central organising concept by collating all the coded data within an identified theme. Some of the codes form main themes, some fall under the category of subtheme and others are disregarded but still important to consider when reviewing the themes (Maguire and Delahunt, 2017). After searching for themes, the next step in the analysis is to review and define the themes. Reviewing the themes involves checking that they agree with the meaning of the coded data segments (Terry *et al.*, 2017). This was accomplished by gathering all the codes relevant into each theme by creating a colour code frequency table in excel (see [Appendix Q](#) for early sample in progress), which contained colour-distinguished codes with their themes and subthemes. It allowed the data to be reviewed against their relevant themes. For example, positive engagement did not work as a theme as only some of the engagement was positive; instead, the theme engagement was used because it had

more data to support the subthemes of positive and negative engagement. Another example reviewed included the subthemes of knowledge and lack of knowledge, which were thought to have too much overlap, so the subtheme was narrowed down to knowledge as that covered all the related codes.

Refining, Defining and Naming Themes

The final part is defining and naming the themes, which aims to help to fully understand each theme (Braun and Clarke, 2006). This was conducted by producing a sample summary code table for all co-design activities in a word document. It included all the themes, subthemes, codes, codes descriptions, the total number of codes and direct quotes. An example of a code description entry in the code table is learnability. This is described as ease of learning. Quotes were included for each code from the participants, carers and researcher. The themes found in the analysis of the Co-design workshop 1 transcripts are UX design, Engagement, Carer mediation, Stranger danger, and Separating spaces. For example, there were several codes relating to comments from the carers; these codes were collated into a theme called carer mediation with a subtheme of carer comment. Once all the data was fully worked out, the results were produced, which involved the final analysis. The results provide evidence of the themes, and data to back up the prevalence of the theme and direct examples. Quotes were referenced in the results first by group number and quote number in the quote diary document.

4.7.3 Lab Sessions: Camtasia Keystroke Recordings and Researcher Observations

Camtasia keystroke recordings of the lab interactions allowed for deeper analysis of data gathered during observations and collection of additional error and task completion data relating to unobserved tasks. Initial data analysis indicated the existence of some specific task-related issues. Data relating to Navigation was coded first as this usually poses issues across tasks (McDonnell *et al.*, 2020). Secondary codes were used which reflected the original observation. These were analysed and refined to identify themes and sub-themes, which reflected the participants' experiences and gave a more comprehensive view of the issues.

Data Familiarisation

Familiarisation with the data was achieved by reading through the texts several times. There were two groups of participant data to analyse: (1) the transcribed texts from the Researcher Observations audio recording in the lab and (2) the Camtasia screen recordings. These are abbreviated in the final table as RO for audio from the Researcher Observations, and CR as Camtasia Recordings. The participants were assigned numbers, and names were never used in analysis nor in the classroom or lab. One issue coded was navigation and in particular, any difficulties that users had, and what they found easy. These two aspects started as codes *Navigation and Usability*. However, over time, *Navigation* became *Findability*, as after reflection, I concluded that this was a more appropriate code. *Findability* then became part of the subtheme *Positive Usability*.

Generating Initial Themes

Some themes were obvious very quickly e.g., *usability and engagement*. However, other themes were generated over time as the codes became clearer. Some themes were discarded, some were split into two sub themes, and some were combined. One such situation was where two codes, *Trial & Error* and *Navigation* coalesced into the single subtheme of *Negative Usability*. Other themes had to be reworked a few times. For example, it was noticed that *Reassurance and Praise* had codes of *Clarification, Focus Attention, Elaboration, Reading and Writing and Reassurance*. The only other time that carers were mentioned was under the theme: *Carer Mediation*, sub theme *Carer Comment*. When the codes were all assigned and the themes assigned, the researcher then looked over the texts again in the light of these themes and codes. Some codes were “tweaked” slightly; e.g., the code “*Likes*” moved from the theme “*Enjoyment*” to the theme “*Usability*” subtheme “*Positive*”. Much time was spent on refining and defining themes, often going back to re-assign codes or themes, as seen above. The initial codes assigned to the text were further refined following considerable reflection. There were several evolving codes and themes. It was not possible to capture all iterations as sometimes themes or codes were changed more than once in one analysis session. At this stage, the themes were becoming more defined. Further refinement then took place leading to the final table of codes, with clear themes starting to emerge. Some further codes were later added. These

were *Frustration* and *Changes to Apply*. A final table was drawn up with themes, sub-themes and codes. For each code a definition was given, together with samples of text to which this code was assigned. The count for each code was also given, to ensure that it was possible to carry out content analysis or research of a more quantitative type should this be required in the future.

4.7.4 Adapted System Usability Scale Questionnaire (SUS)

This lab session thematic data was then triangulated with the answers the participants gave to the adapted usability scale completed by participants. Reported usability and engagement scores were calculated based on participants' self-reported responses to questions in the SUS relating to ease of use (seven questions) and likeability (seven questions) respectively. One of the aims of the present study was to continue to explore *usability, satisfaction and engagement issues* in a cybersafety training prototype for young adults with ID. Themes emerged from the quotes from researcher observation comments during the lab sessions for all groups of participants respectively. This data was once again triangulated with the answers the participants gave to the adapted system usability scale (SUS) questionnaire.

4.8 Methods Summary

The purpose of this chapter was to discuss the operationalisation of the research approach adopted in this *CyberSafe* study. An overview of the research tools developed for each stage of the research process was described. A description of the interview schedule, survey questions, the workshop tools and procedures was provided. The chapter then went on to describe how these methods informed the artefact that was codesigned. Incorporating feedback from users helped to develop the design iteratively from early paper prototyping, to digital prototypes through repeated cycles of design and evaluation. A description of the profile of each of the participant groups was provided. Finally, in the interests of transparency and reliability, the chapter discussed the researcher's overall approach to data consistency, validation and analysis.

5. THE CYBERSAFE APP - DESIGN AND DEVELOPMENT

5.1 Introduction

This chapter documents the development of the *CyberSafe* prototype and the interface design decisions made at each key stage based on stakeholder and participant data collected during the research study's data collection points. The data collected in this study was analysed and used to inform fundamental design decisions throughout development. As advised by the user-centred design (UCD) process and co-design approaches outlined in Chapter 4, feedback from participants informed the iterative designs from early paper prototyping, to digital prototypes through repeated cycles of design and user evaluation.

Phase one of the research, based on interviews with stakeholders, identified a clear need for the development of accessible educational materials about internet safety for PWID. The stakeholders proposed educational content on the following topics:

- Cybersafety
- Respect
- Cyberbullying
- Personal Information
- Stranger Danger
- Privacy settings
- Coco's Law
- Social media Blocking and Reporting.

The user-centred design (UCD) process in Phase two of the research involved 12 and 9 participants, respectively, interacting with two iterative prototype designs. In Phase three, I conducted a final evaluation of the usability and engagement of the third and final version of *CyberSafe* with 11 new participants with ID. This chapter begins by presenting *CyberSafe*'s user personas and empathy diagrams, developed from the first round of PWID empathy workshop data. It then presents how content was chosen for the educational application. The chapter concludes with a description of the rationale for including an interactive video component about catfishing and an interactive exercise component for Snapchat for the final round of lab usability and engagement testing.

5.2 Phase 1 Defining User and Design Requirements

The aim of the *CyberSafe* application is to educate PwID between 18-34 years about cybersafety. The feedback from the stakeholders and PwID participants themselves is described in detail in Results Chapter 6. Stakeholders recommended a clear small step-by-step instructional process containing multiple modalities (video, audio, graphics and limited text). Respondents indicated there was a need to train the target users around every individual app (SnapChat, WhatsApp, and Instagram etc.), even though the information can be similar. Simplicity appeared to be the key point raised by stakeholders, with respondents recommending clear small sections of content. The qualitative insights from the 12 PwID in Phase 1 in the early empathy workshops highlighted their need for educational content about:

- Different app privacy settings
- Stranger danger issues
- Celebrity catfishing.

Celebrity Catfishing is the phenomenon, whereby scammers pretend to be celebrities to take advantage of other social media users, usually asking for money with an elaborate excuse, or to meet in person, after fostering a relationship with them. Professionals, support workers and PwID all proposed similar features. These suggestions informed the key features to be included in the educational application. Based on this feedback from the empathy workshops, the first UCD research activity utilised persona development and empathy mapping. This was conducted towards the end of phase 1, after analysing the data from the empathy workshops. The goal of this activity was to better define users and their characteristics, as well as being considerate of all potential users, no matter what their technical ability or goals or expectations were (Blomquist and Arvola, 2002). To support user understanding, empathy maps were completed for each persona. This activity helped externalise what was known about users and created a better understanding of user needs, which assisted in the making of design decisions (Gibbons, 2018).

5.2.1 Persona Characteristics

Two personas were developed, John and Mary (see Figures 24 and 26). The two personas depicted a sample of the user group for whom the application was being created. For the persona Mary, her frustration is evident with lack of access to the internet and devices but at the same time, she is fearful of strangers online. John is keen to connect with people online and via social media. He is frustrated that he has limitations that others his age do not, and he is frustrated with these limitations. He is aware of scammers online but does not like talking about it. For Mary and John, having all their needs and frustrations in one place highlighted what topics should be addressed in *CyberSafe*. The aim of these personas was to use clear language to describe Mary and John's needs and frustrations. Often, designers refer to their own opinions and not to personas in their design decisions. The designers who create the personas, tend to refer to them more. They become like protectors of the persona (Friess, 2012). The empathy maps (see Figures 25 and 27) were based on an amalgamation of the data from the first two empathy workshops with PwID. Traditional empathy maps are split into four quadrants (Says, Thinks, Does, and Feels), with the user or persona in the middle. Empathy maps provided a glance into who a user is as a whole and are not chronological or sequential (Nielsen group, 2023).



John

Name: John

Gender: Male.

Age: 20.

Impairment: Mild

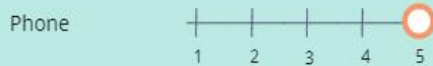
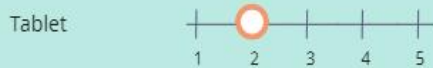
About John

In his free time, John loves to play videogames and watch youtube videos, especially youtube videos concerning games.

He also loves being outdoor and playing sports with his friends, as well as playing videogames with them.

"I got a pointer on that as well. When the phone rings, mom would always get these dodgy numbers online that try take money off you."

Technical knowhow



Most frequently used applications:



Facebook



WhatsApp



YouTube

Devices used:

Computer

Tablet

Phone

Requirements:

- Safer online use.
- Knowing who's real.
- Privacy settings.

Frustrations:

- Lack of autonomy at times.
- Irritation
- Lack of cybersafety education.

miro

Figure 23 Persona 1

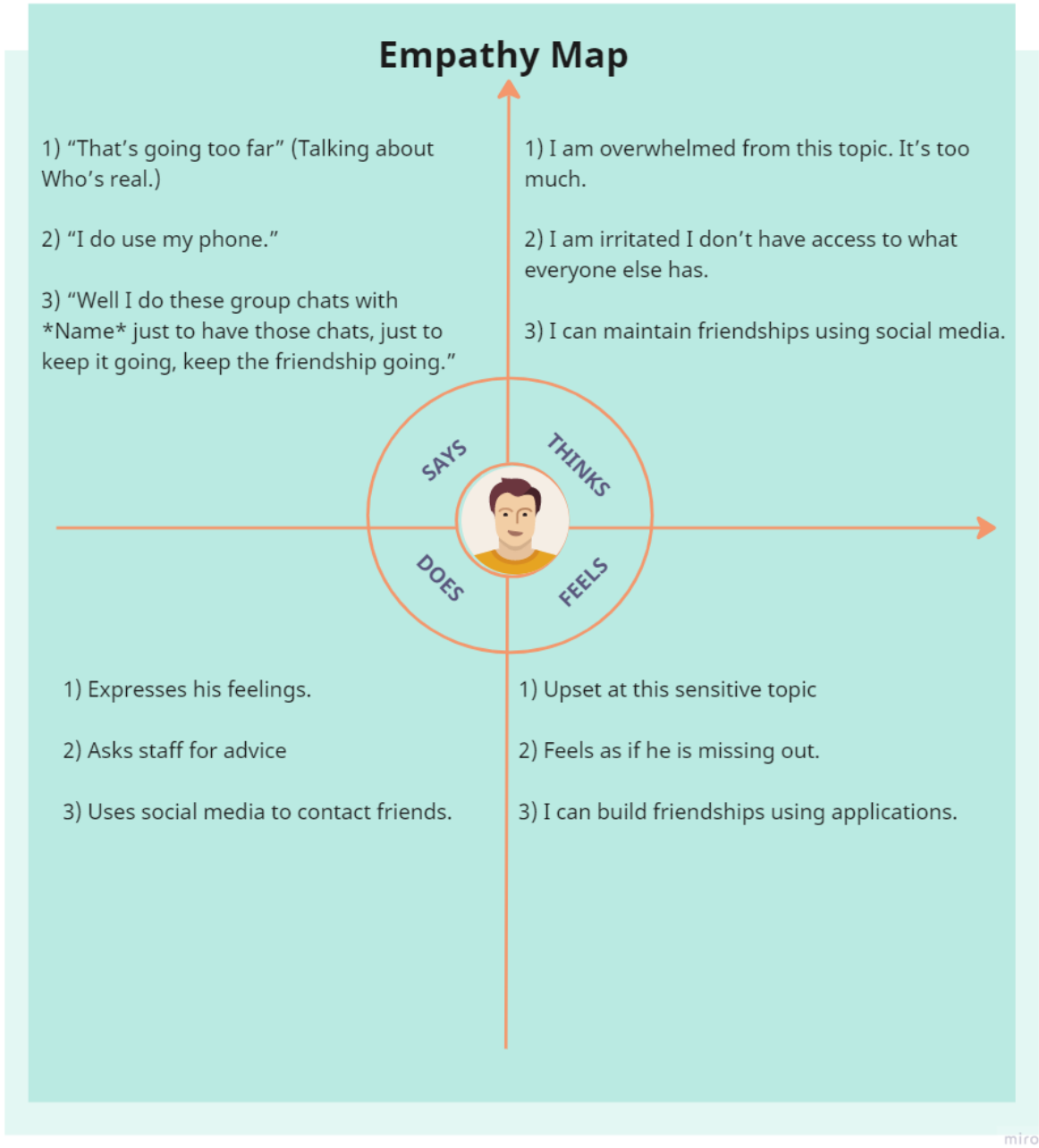


Figure 24 Empathy map created for persona 1



Mary

Name: Mary.

Gender: Female.

Age: 20.

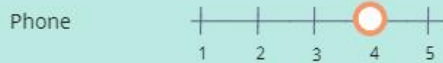
Impairment: Moderate.

About Mary

In her free time, Mary loves to listen to music and dance, her favourite artist is Harry Styles and she hopes someday she can see him in concert. Mary also loves her friends, with whom she likes to get coffee and talk.

"I got bullied on my WhatsApp. I got mean text messages, that's not nice so I blocked them from my WhatsApp and deleted their phone number. I carried on with my life."

Technical knowhow



Most frequently used applications:



Facebook



WhatsApp



YouTube

Devices used:

Computer

Tablet

Phone

Requirements:

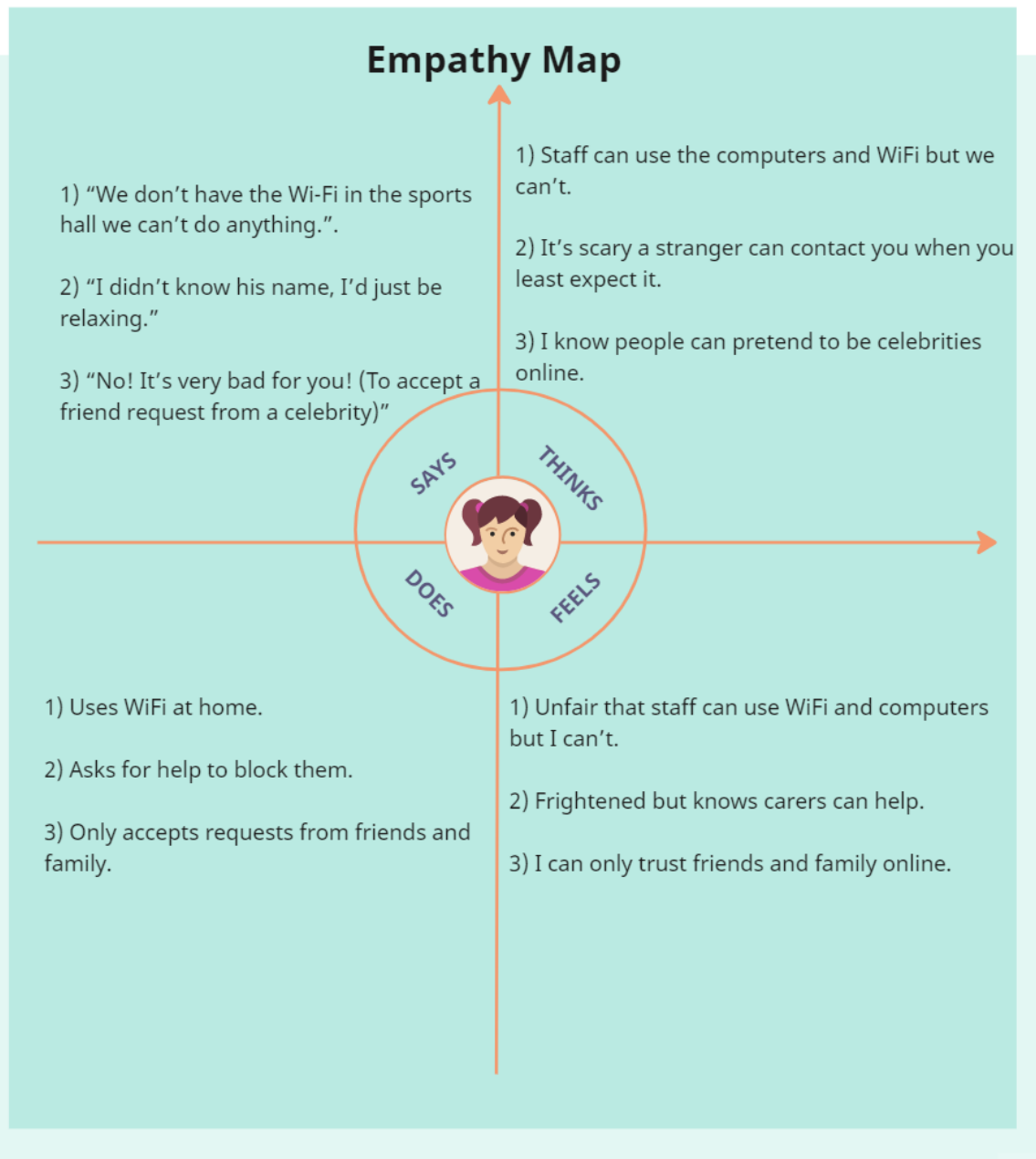
- more accessibility
- wants to know who's a real friend
- wants to know how to block people

Frustrations:

- lack of autonomy
- lacks access to WiFi
- lack of access to devices

miro

Figure 25 Persona 2



miro

Figure 26 Empathy map created for persona 2

5.3 Prototyping the *CyberSafe* application

Findings from the workshops conducted, stakeholder interviews and questionnaire results and various iteration usability testing feedback, resulted in multiple iterations of the prototype from paper to medium and high fidelity digital versions, in order to develop a practical and useful application. This section will discuss these various prototyping stages.

5.3.1 Paper prototypes

Multiple low-fidelity paper prototypes were created first to reflect the concept as it developed. Paper prototypes had the advantage of being faster and easier to create than high-fidelity prototypes, while at the same time functioning as a visual aid for identifying where modifications were required in the app. Based on the process, additional links and functions were added to ensure users could be guided to the function and content they needed. As the design of the prototype progressed, paper prototypes and wireframes of the app were demonstrated to expert stakeholders, support workers first and then to PWID to receive critical feedback on the designs (see Figure 28 for starter sample paper screenshot for desktop and tablet for the proposed cyberbullying page of the *CyberSafe* application in early stages of design).

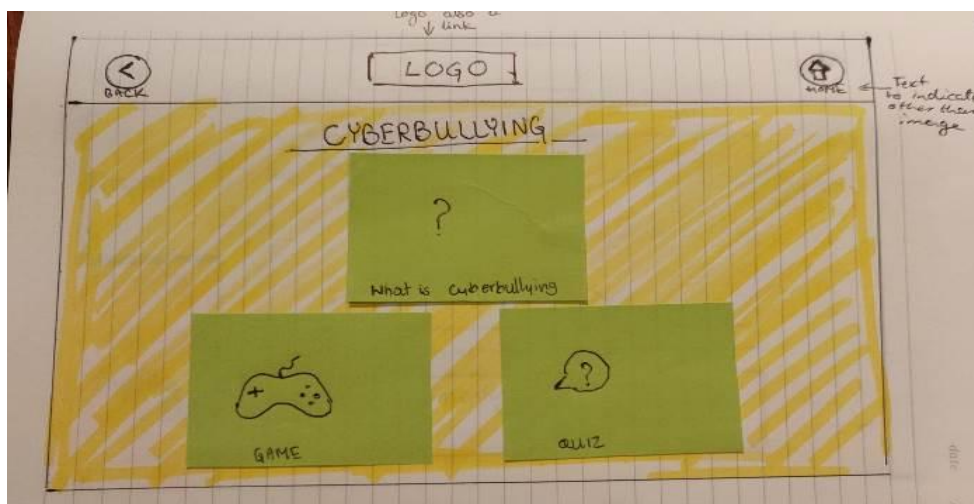


Figure 27 Sample Cyberbullying page paper prototype

5.3.2 Digital prototypes

CyberSafe started on paper, then moved onto a mid-fidelity digital prototype. This approach is proposed as a good technique and one vital ingredient in order to deepen the engagement of participants with ID (Sitbon and Fahrin, 2017). Informed by the personas,

empathy maps and findings from the first codesign workshop, the first iteration of the *CyberSafe* application was designed.



Figure 28 Proof of concept early Homepage

This early-stage design work was primarily driven from a technical feasibility and hypothetical standpoint. Informed by my earlier involvement in the Erasmus+ Disabuse Project (2017-2019) where the interface design was deemed to be neither modern enough nor cool enough by PwID, its target users, I was keen to avoid this mistake. As I had observed from this earlier project that PwID want to be like everyone else (González-Calatayud Roman-García and Prendes-Espinosa, 2021), therefore I believed that it was important that the *CyberSafe* application would have the requisite kerb appeal.

5.3.3 High fidelity prototype

It was my aspiration, in the first iteration of the prototype at least, that by following the *Design for All* path, that the proposed application, though targeted initially for PwID may end up being usable and accessible to all users— independent of age, cognitive ability or background education (Miesenberger *et al.*, 2020). Universal Design principles highlight how picture icons can be used as symbols for the objects they depict for this user group. Thenounproject.com create icons that speak for themselves without words and form a new worldwide visual language (nownproject.com, 2021). These icons follow the style of the icons produced by the American Institute of Graphic Arts (AIGA). Furthermore, the

development of the *CyberSafe* prototype was designed in accordance with key Interface Design principles as recommended in the literature (see Table 14).

Table 14 Interface Design Recommendations from the literature

Concepts	Main recommendations
Content	<ul style="list-style-type: none"> • Include game elements. e.g puzzles (Rocha, Bessa, Magalhaes <i>et al.</i>, 2015; Saridaki and Mourlas, 2013). • Use of graphics, video and audio (McDonnell, Connolly, and Abbes, 2018).
Navigation and graphic design	<ul style="list-style-type: none"> • Consistent layout and simple menu; • Easily identifiable and relatable symbols; • Warnings and feedback to remain on screen until user acts on them; • Minimise user input; • Consistent interface with simple structure; • Accompany user input with labels or instructions; • Larger clickable areas; • High contrast between text and background colours. <p>(Deklever <i>et al.</i>, 2015)</p>
Text	<ul style="list-style-type: none"> • Relatable images to reduce cognitive load on the user; • Plain and concise language; • Text alternatives for non-text content <p>(Deklever <i>et al.</i>, 2015).</p>
Personalisation	<ul style="list-style-type: none"> • Limited number of functions to avoid cognitive overload <p>(Deklever <i>et al.</i>, 2015).</p>

Learners’ navigational requirements were addressed by including two navigation icons at the top of each page. To avoid getting lost, the home and back navigation buttons

were displayed on each page (see Figure 30). Once in the module content, two other arrow icons direct the learners to the next page of each module or back a page.

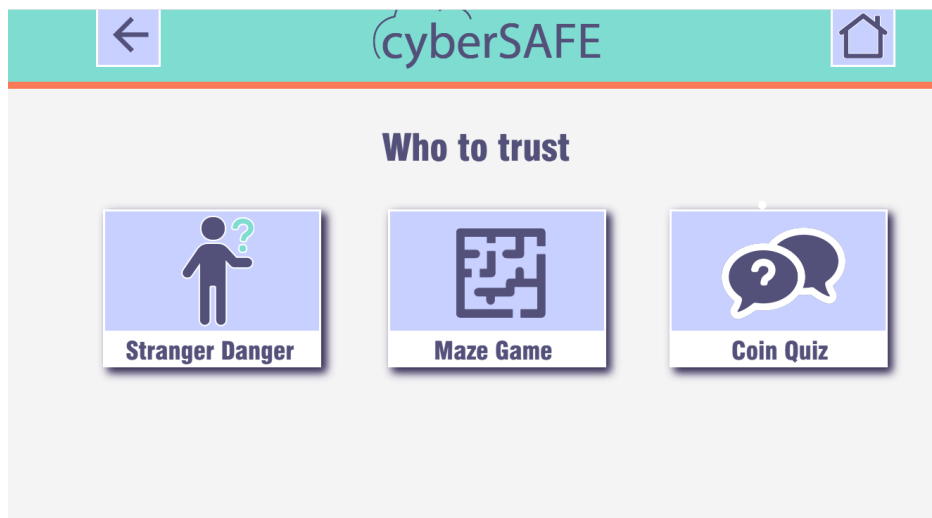


Figure 29 Home and back navigation buttons on each page

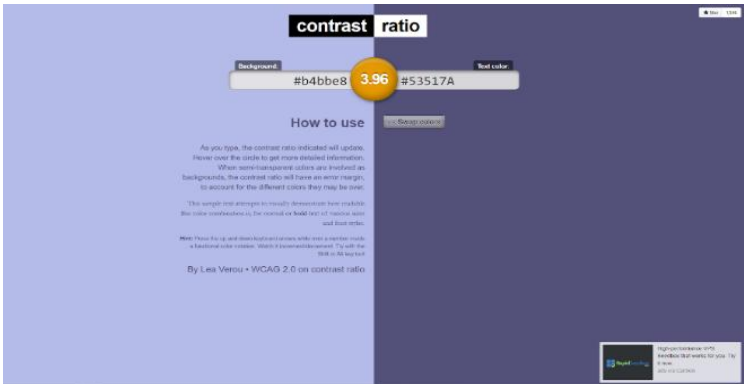
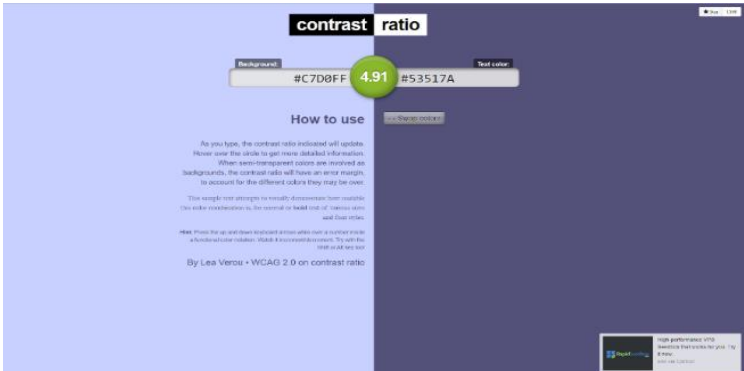
5.3.4 Colour in Accessibility

Colour choice is important as a calming effect, as students with ID show higher levels of anxiety than their neurotypical counterparts (Carroll and Iles, 2006). *CyberSafe* considered the readability of the application in regards to students with reading challenges. Lazar, Goldstein and Taylor (2007) outline numerous preferred design aspects such as:

- Italic serif fonts were favoured.
- Fonts with bright colours and outlines were liked,
- Along with large words with heavy bold treatment.
- Accentuated and stylized fonts (with stars and arrows) were also desired.
- Colour choice was subjective, although nobody was in favour of dull colours.
- There were strong preference for inclusion of images.
- Images of young attractive people were liked in particular
- Along with action and sport images.
- Images of people of similar age attracted more interest.

Rello and Bigham (2017) conducted research with 341 students, 89 of whom had dyslexia, and found that warm background colours such as peach, orange and yellow significantly increased the reading performance of participants over cool colours such as green, blue and grey. Unfortunately, it seems that there is very little overlap in colours, which provide both a calming effect and a good level of readability. Also Simmons (2011) conducted a study on the different emotional responses certain colours elicited and found that light blue, lilac and light orange (in order) were the three most calming colours. Accordingly, lilac was chosen for this first draft homepage with an appropriate font colour to meet accessibility guidelines. Of course, colour should not be the only means of conveying information, and it is recommended that the text contrast ratio to background should be no less than 4.5:1. Designing *CyberSafe's* design and development, these contrast ratios guided with decisions as to how the content would be shown and what colours would be used for text and background combinations. Similarly, for non-text graphics, the guideline that the contrast ratio should be no less than 3:1 was followed.

Table 15 Contrast Ratio checker scores for 2 shades of lilac with appropriate font colour

Iteration	Colour Code
<p>First Iteration</p>  <p>The screenshot shows a web-based contrast ratio checker. At the top, it says 'contrast ratio'. Below that, there are two input fields: 'Background' with the value '#b4bbe8' and 'Text color' with the value '#53517A'. A large orange circle in the center displays the calculated contrast ratio of '3.96'. Below the inputs, there is a 'How to use' section with instructions and a 'Check color' button. The background of the tool is a light purple/lilac color.</p>	<p>Pastel lilac colour (hex code #b4bbe8) resulting in colour contrast score of 3.96.</p>
<p>Second Iteration</p>  <p>The screenshot shows the same contrast ratio checker tool. The 'Background' input field now has the value '#c7d0ff' and the contrast ratio displayed in a green circle is '4.91'. The rest of the interface, including the 'Text color' field and 'How to use' section, remains the same. The background of the tool is a lighter shade of purple/lilac.</p>	<p>Lighter shade of lilac (hex code #c7d0ff) resulting in colour contrast score of 4.91</p>

Based on text presentation in readability studies (Gregor and Newell, 2000; Rello and Baeza-Yates, 2012), the san serif font Swiss 721 Black condensed was chosen for this first proof of concept early homepage. In the first iteration of the homepage, the background colour was a pastel lilac colour (hex code #b4bbe8). Due to the low colour contrast for the background and the text colour (hex code #53517a), the background was changed into an even lighter shade of lilac (hex code #c7d0ff), which met the requirement of contrast (see Table 15).

The contrast ratio can be checked online through <https://contrast-ratio.com/>. All throughout this process, the screens were constantly checked making sure that they met accessibility considerations e.g., the contrast ratios and colour-blind views. Colour blindness affects 8% of males and there is a higher number of males in the ID population. The most agreed upon research recommendations were implemented. The best recommendations were to use symbols as well as text, implement consistent navigation and design, and use headings titles and prompts so that the user always knows where they are. In *CyberSafe*, I aimed to ensure that the language was simple, the design consistent, with indications of where the user is at all times and the contrast levels for text at the 4.5:1 ratio were met.

5.3.5 Language style and consistency

Consistency in web design is vital for PwID, as they heavily rely on a clear and consistent navigation, and using hierarchical structures supports orientation, and improves usability (Matausch, Peböck and Pühretmair, 2012). Sentences should fit in one line, unless when a sentence is longer, the sentence should be broken up. The average optimal sentence length is found to be between 15 and 20 words. The text should have clear headings and subheadings, content is provided on one screen with minimal vertical scrolling and also the text is in the middle or on the right side of the screen and does not take up the whole screen. Further work on *CyberSafe*, to meet these guidelines, continued with each fresh iteration. A substantial amount of content was added for the various menu items. Graphics, videos and audios files were created based on the identified and expressed needs of PwID's and stakeholders. Depending on feedback, different menu items were adjusted, an example of which is demonstrated in Section 5.4.

5.3.6 CyberSafe Application Content

After all exploratory research methods were conducted, and user and design requirements were defined, I made the following design decisions:

- The core app functions would include six modules entitled: Cybersafety, Trust, Personal Information, Respect, Safety and Privacy.
- Each module would have three components, represented via three menu items. Each page had a home button to go back to the main page and a back button to go back to the previous content.
- Each of these three components would contain different types of media content e.g., graphics, videos, audio, quizzes and games.

5.3.7 Use of Videos

Usability and engagement tests were conducted in Phase 2 of the initial designs with 12 participants to get early feedback and iron out any issues with the prototype or task flows.

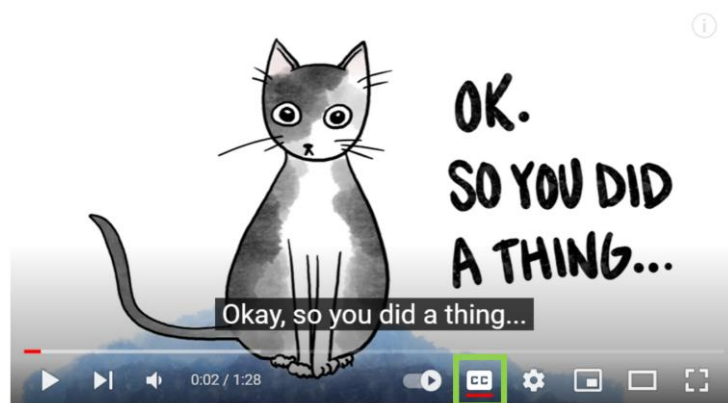


Figure 30 Captions optional button

Since this *CyberSafe* research study began in 2018, videos are being viewed by users on all online and social media platforms in greater numbers. Videos have become an integral element of the internet experience, particularly on social media, e.g. Instagram, TikTok, or YouTube. In the context of *CyberSafe*, it is interesting to note that, according to Cisco, 82% of internet traffic in 2022 was made up of video. However, not all video content is effective. As

noted by Sprout Social (2022), more than 66% of internet users claim to pay the greatest attention to short-form videos but the definition of "short-form" still depends on the kind of video and the social media platform used to share it. For example, videos on Instagram's feed usually last for 26 seconds whereas Facebook videos with a runtime of between two and five minutes are more engaging. In *CyberSafe*, videos were created and some were selected for use on YouTube, using a mixture of animated characters and individuals talking. An effort was made to source videos made by peers, the same age of the user group, as the PwID indicated that they preferred this. Some suitable material (on scamming, respect etc.) was found, which provided audio descriptions and subtitles for all the content for individuals with hearing issues or visual impairment (see Figure 31). It is recommended for accessibility that the videos have captions. Many of the videos made by peers, the same age of the user group were sourced from YouTube. These contain an option to use captions and change the speed as one pleases. Some videos were made by student volunteers in IADT (e.g. App privacy settings for YouTube, Snapchat, WhatsApp, and TikTok). See a list of videos sources and student videos at [Appendix L](#).

5.4. Phase 2 Iteration testing: Rounds 1 and 2

After the initial research was conducted in Phase 1, the data and insights gathered were used as design input into Phase 2. Improvements required were noted. A mid-fidelity prototype was then produced, to implement feedback from the iteration tests. Using these refined design requirements, the mid-fidelity prototyping design system was tested with the participants. The tests were structured around scenarios or tasks informed by the subject matter experts' survey. Data collected using this method was centered on the participant's thoughts while interacting with *CyberSafe* e.g., PwID participants said that some of the main screen icons could look simpler, e.g., the Safety menu icon. Consequently, hands and heart were removed from this icon. Similarly, the Respect menu icon was considered too crowded.

See Figure 32 and Figure 33 for before and after changes to Home page menu icons



Figure 31 Before Home page menu icons



Figure 32 After Home page menu icons



Figure 33 Cybersafe Application (Re-iterated Home page of High-Fidelity Prototype)

5.4.1 Phase 2 – Round one Iteration testing

In iteration testing phase 1, participants were asked to complete three tasks:

- Play the Cyberbullying video.
- Play the Maze game
- Answer a quiz on Cyberbullying

Iteration testing revealed issues with the Adobe XD prototype, specifically screen linking and clicking issues. Participants and support workers, present in the lab session, also suggested the following changes:

- Add audio to Quiz components.
- Color code Quiz answers

- Add content on Stranger Danger
- Add content on Privacy settings in YouTube and What's app
- Add badges To Game and Quiz components. Badges were selected in the first co-design exercise by the participants as their reward symbol of choice.
- Keep consistent red arrow YouTube interface to play video clips

The second iteration of the prototype implemented these suggestions. The only challenge was implementing audio in the prototype as Anima App does not support audio. The iteration testing process was then conducted in the same fashion as the first round of testing.

5.4.2 Phase 2-- Round two iteration testing

Table 16 highlights the main changes implemented in the second prototype used for testing.

Table 16 Recommendations for changes for 2nd round iteration testing and the solutions implemented.

Problem	Recommendation	Solution
Students like badges or streaks	Maze and Coin game need reward elements	Final Screen for Maze Game now has badges Badges also added to new Friend or Fake game
Literacy with Quiz answers	Quiz answers need colour coding	Cyberstalking Quiz Screen now colour coded
Games not automatically loading in AnimaApp	Move game prototypes to XD only	Maze and Coin Games automatically loading in Adobe XD
Playing videos	YouTube red Play button needed to play all videos	All videos uploaded to YouTube channel

The original tasks used during round two iteration testing were extended to ensure participants were still required to use the applications' main functionalities while

simultaneously ensuring they were not overwhelmed. Participants were asked to complete five tasks:

- Play the Cyberstalking video.
- Play the YouTube Privacy settings video on Blocking
- Play the YouTube Privacy settings video on Reporting
- Answer the Cyberstalking Quiz
- Play the Coin Game.

I used observation as a methodological tool during these testing sessions in the lab with users. Camtasia screen recordings of their keystroke interactions with the prototype as well as researcher observations were recorded.

Suggested changes after this round included:

1. Break videos down into steps.
2. Add a video component which provides branching choices for the user
3. Add exercises with videos
4. Colour code answers in Coin Game
5. Change quiz host character in Coin game

Detailed results from the Camtasia recordings, my observations and user feedback are presented in Results Chapter 6. The results of the second round of testing provided further feedback on the prototype. As the majority of participants struggled with the video about managing their privacy settings, I decided that a more step by step instructional video would be required to help them navigate this process. Therefore, the decision was made to break the privacy settings video into steps. The feedback and data gathered informed the final iteration of the hi-fi prototype. This iteration was then refined for the final usability and engagement evaluation.

5.5 Phase 3 Final Evaluation

Based on the two rounds of iterative testing in Phase 2, a final iteration was achieved available to view <https://weathered-cell-5036.animaapp.io/homepage>. For the Phase 3 final evaluation, additional content was refined and added, based on the second Co-design workshop feedback and iterative testing sessions in Phase 2. This content included an interactive video component on catfishing and an interactive exercise on blocking and reporting in Snapchat. The feedback gathered from the second round of testing was analysed and then problems were addressed (table 17), resulting in the final design iteration that was ready for final usability and engagement testing.

Table 17 Problems found during round 2-iteration feedback

Problems	Solutions
Video too fast	Videos broken down into steps
Video still too complicated	Video content made simpler
Videos not interactive	Catfishing video is now interactive
Videos needed exercises to engage	Snapchat Videos have Try it yourself exercise
Change character in Quiz game	New character introduced

Co design workshop 1 in Phase 2 had experimented with user choices around quiz backgrounds, game characters and main menu icons. One of the exercises asked the participants to choose their favourite character from a list of three. Each of these three characters were demonstrated asking questions about accepting friend requests online in a prototype Coin game. The interactive Coin game invited the participants to click the correct answer about a friend request on Facebook to win a coin. The purpose here was to get insight into the participants preferred representation of the host in the Coin game, which

aimed to instruct about who to trust online. The first character was a caucasian blonde woman who was voted the most popular by the participants. The second character was a brunette woman. The third character was a young man with a cool haircut. Results are shown below.

The 12 participants across the 2 groups voted as follows:

Group 1: 5 for character 1, 1 for character 3

Group 2: 2 for character 1, 4 for character 3

Character 2 was not chosen

Participants preferred the blonde woman although the young man with a cool haircut was a close runner up. The 12 participants included 8 males and 4 females, a gender breakdown of 2:1 male to female. This is in line with general ID population figures. There was a larger number of males and this could indicate why the blonde woman was preferred, representing a very neurotypical response. See Figure 35 for this sample new character introduced to the Coin Quiz game, based on user feedback in Co-design sessions.



Figure 34 Changed character in Quiz game



Figure 35 Original character in Quiz game and character 3, young man with a cool haircut

5.5.1 Branching Video Component

The suggestion by the support workers to add an interactive video component was investigated. Academics have recognised interactive video interactions as a successful teaching method because they combine kinesthetic and visual learning techniques with narrative structure (Desai and Kulkarni, 2022). In order to create an effective interactive video for *CyberSafe's* e-learning environment, I considered three factors: reducing the cognitive load, increasing students' engagement, and achieving active learning (Afify, 2020). The process for creating an interactive video component and adding an exercise to the privacy settings videos and breaking the videos down into steps is described in the next section.

The initial concept draft involved a short film narrative about a catfishing scenario for financial gain, with six individual video clips. The video clips were organised so that the user could make decisions for the protagonist character determining the narrative outcome. To facilitate this structure, the developmental process required multiple visual references. These included storyboarding, Miro and Figma prototyping. To accommodate users with limited literacy skills, voice-over dialogue was recorded to vocalise the text messages by a Snapchat hacker shown on screen. That text information was also visible on the actor's phone on the screen to read. The introduction of vocal narration was beneficial for the users, and it enabled an opportunity for deceptive persuasion through a friendly-seeming catfish voice.

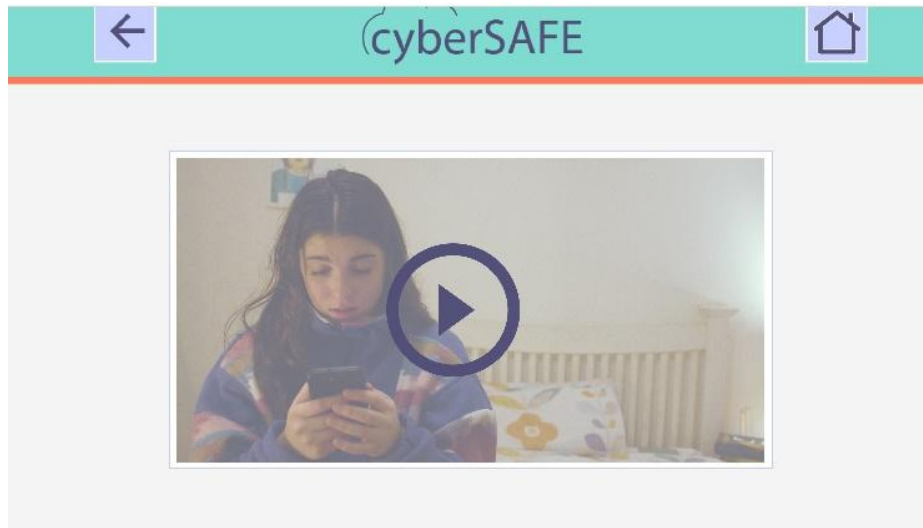


Figure 36 Catfishing Video page

Video filming took place over the course of two days with exacting measurements being taken for the branching framework to flow with consistency. See Figure 38 for branching node diagram showing decision tree presented in the interface to viewer. Adobe Premiere Pro was used for video editing. This process involved sequencing, trimming, audio mixing and colour grading using the adjustment layers and effects tools. The process of branching the individual film clips was executed using Adobe Captivate. The video clips were imported and separated among PowerPoint slides, then branched using overlay wireframe tools. The final video branch prototype was then exported as a HTML5 file, accessible through a Chrome Index shortcut. These HTML files and related assets were then uploaded to Blacknight hosting service and linked to the *CyberSafe* prototype on the anima app server. See Figure 38 for a screen grab for two decision points e.g., reply or ignore and get tickets/block Ben.

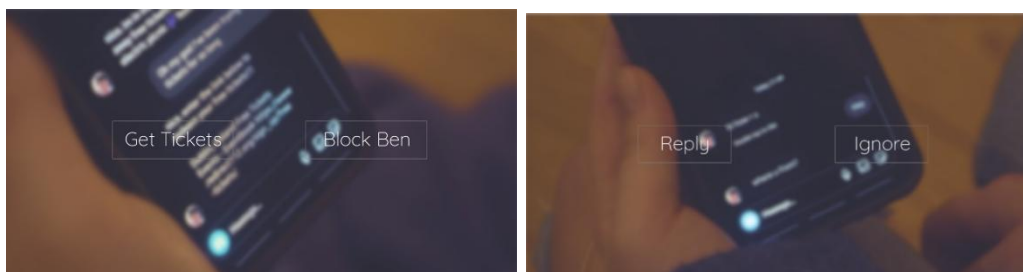


Figure 37 Interactive Choice Titles

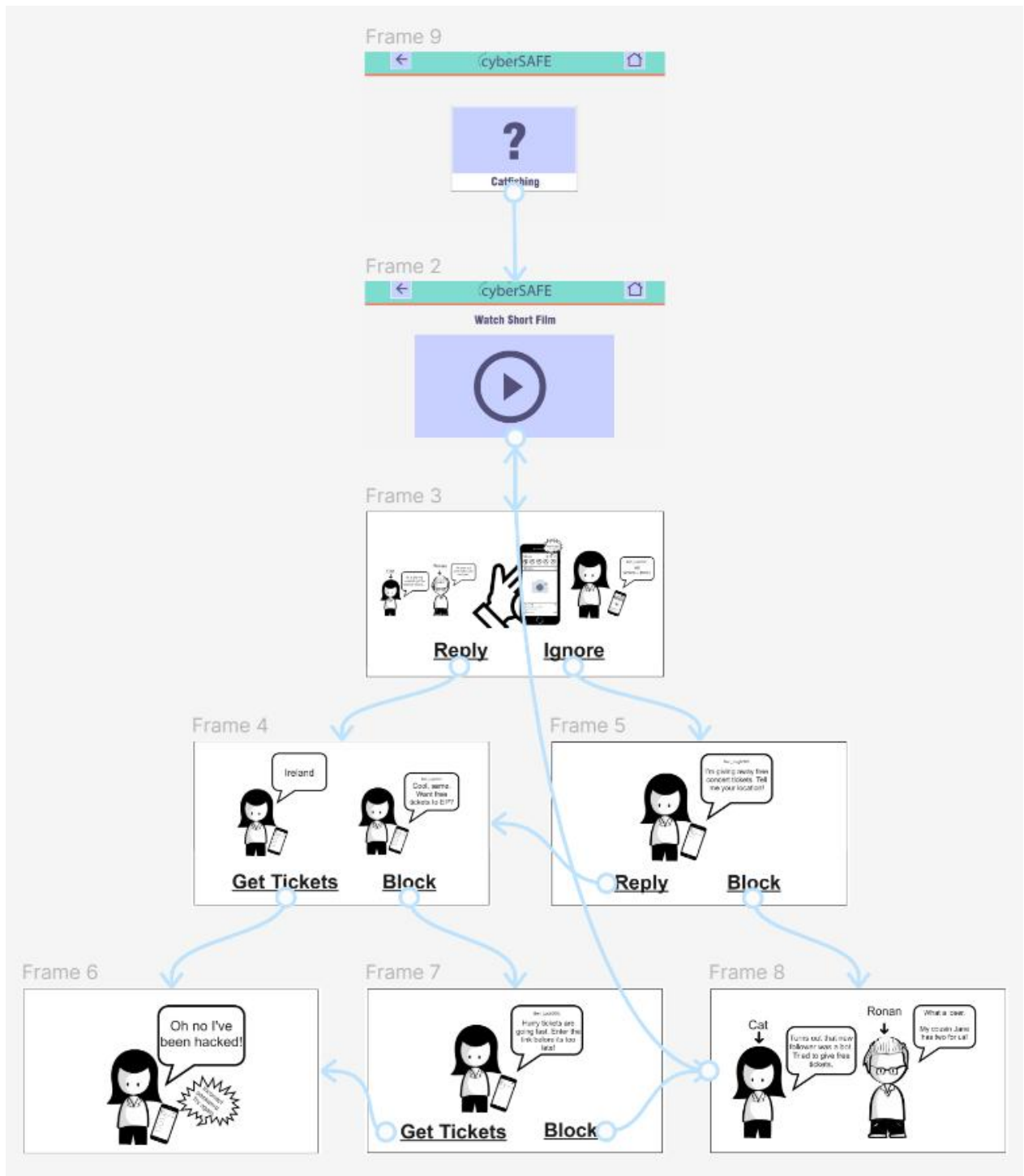


Figure 38 Branching node diagram

5.5.2 Interactive exercise for SnapChat Video component

Feedback from the second iteration in Phase 2 confirmed that instructional videos should be no longer than approximately one minute. Following this recommendation, instruction videos were added to the “Snapchat” Privacy settings section. These videos are approximately one minute long and the narration was supported by the automatically generated captions. The “Veed.io” online tool was used to generate the captions. Captions added to the videos are in the “Roboto” sans serif font (see Figure 40).

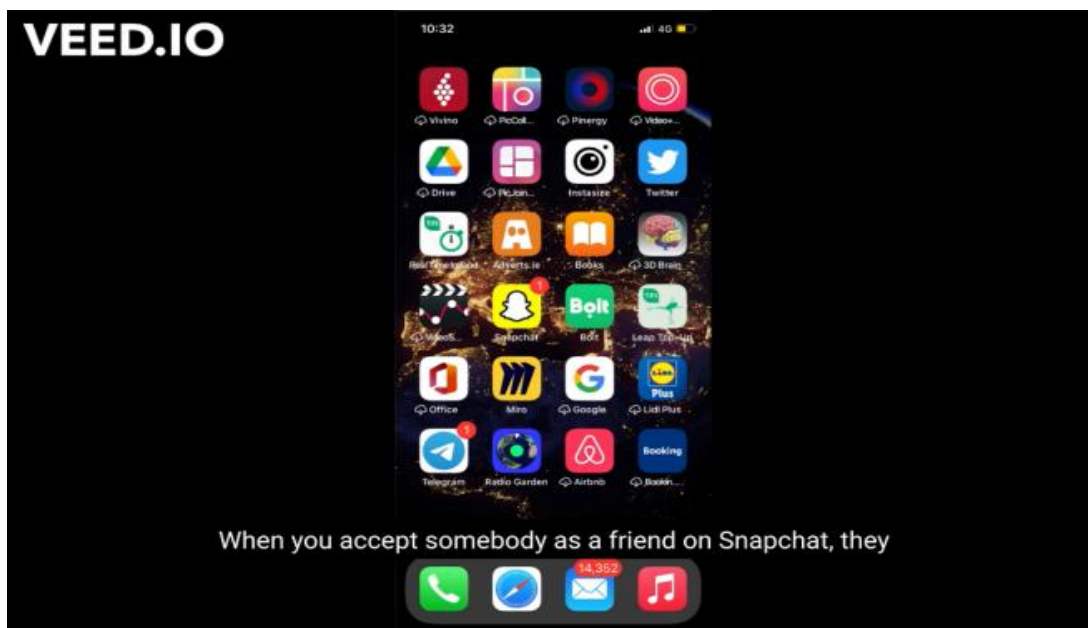


Figure 39 “Snapchat” section, video with captions

An interactive Figma aspect in the Snapchat section was implemented. This used the existing Snapchat interface design, with implementation of a relatable user avatar with whom users with ID could interact (see Figure 41). Here the users interact with the interface and block and report the offending Snapchat user themselves. The topic includes an interactive Figma prototype, which entails redirection to another website (Figma.com).

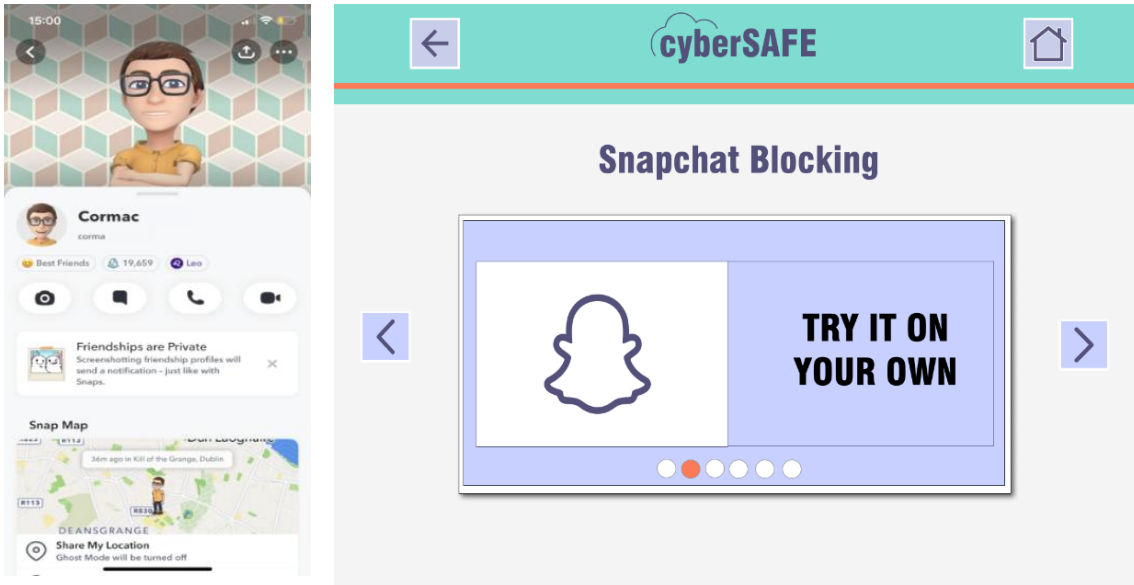


Figure 40 Snapchat display

Table 18 New tasks for final round of usability and engagement testing

Original tasks Nov/Dec 2022	Final New tasks April 2023
Play the Cyberstalking video.	Do the interactive video exercise on Catfishing
Play the YouTube Privacy settings video on Blocking	Play the Fake or friend game
Play the YouTube Privacy settings video on Reporting	Work through the interactive Snapchat privacy settings exercise
Answer the Cyberstalking Quiz	Play the Whats App privacy settings step by step videos
Play the Coin Game.	Play the Coin Game.

One final round of usability evaluation was conducted with 11 new participants to catch any issues with the new high-fidelity prototype. Results from this final evaluation and all results from previous phases will be presented and discussed in the next chapter.

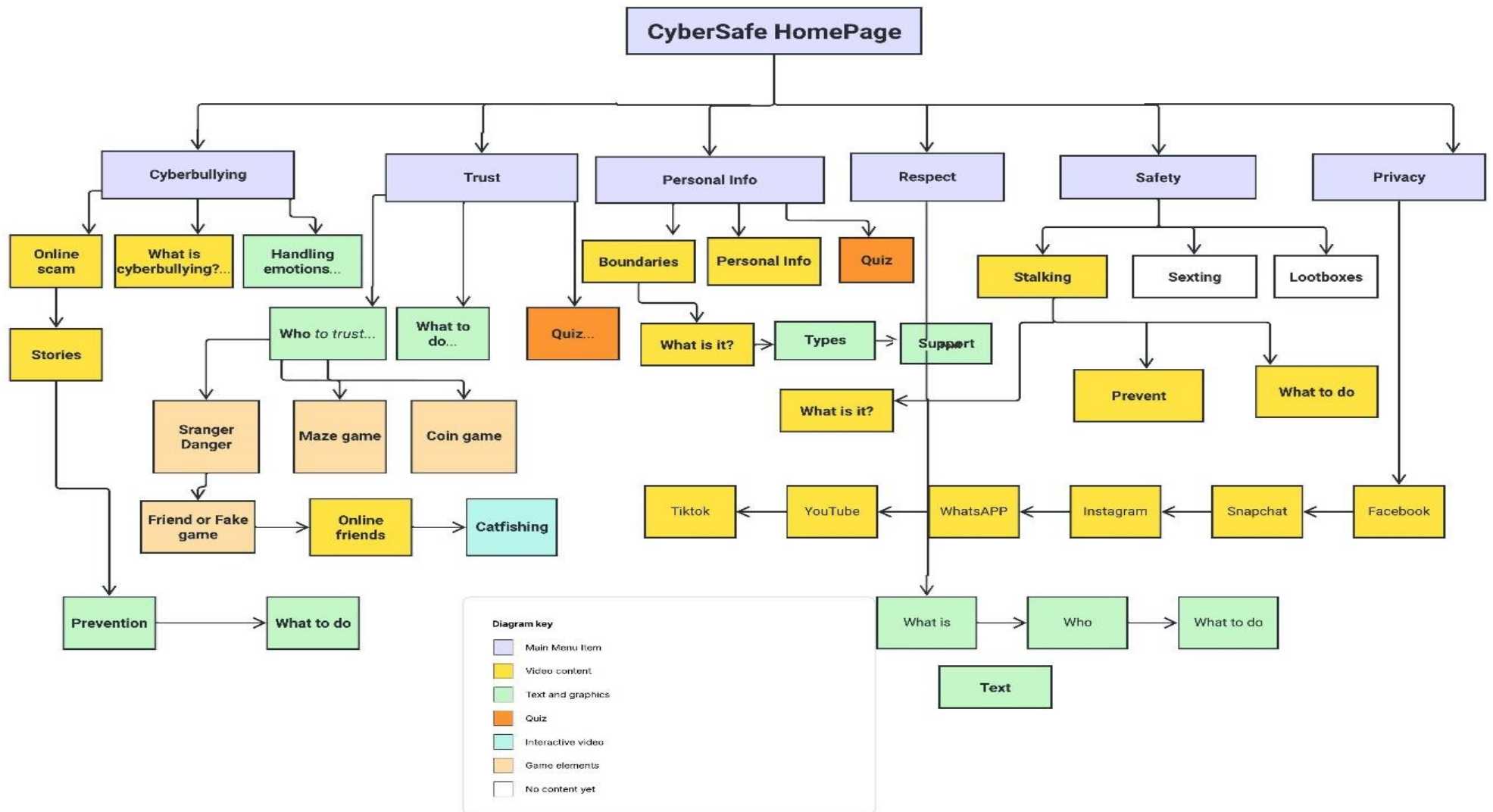


Figure 41 Final CyberSafe Flow diagram

The final *CyberSafe* prototype application is hosted online at <https://weathered-cell-5036.animaapp.io/homepage>, and is a standalone instructional application, covering six modules which are fully interactive. The six modules include CyberSafety, Trust, Personal Information, Respect, Safety and Privacy. For example, there are video clips on the various topics highlighted in yellow in Figure 42: e.g. What is Cyberbullying, Boundaries, Personal information, Stalking, Online friends and privacy settings for Tiktok, Youtube, Instagram, Whatsapp, Snapchat and Facebook. There is one interactive video about catfishing. There are pages with simple text and appropriate graphics covering topics like Who to trust, what is respect etc. There are two quiz components highlighted in yellow: one dealing with who to trust and the other dealing with personal information. There are three game components (Maze, Coin and Friend or Fake games) highlighted in light peach shade in Figure 42.

5.6 Future of *CyberSafe*

Early stakeholder interviews highlighted that the service providers and service users involved would use the artefact in their educational initiatives. *CyberSafe* is a hybrid prototype web application, which can run on mobile, tablet or desktop as an educational tool. The prototype was built using the software Adobe Illustrator and XD for iterative design, and Anima app (which allows Adobe XD to accommodate video hosting and testing). Just in Mind, Invision and Maze were also investigated as possible platforms. Unfortunately, neither Just in Mind, Invision or Maze, at the time of design, allowed for video and audio links to be run in the digital prototype. However, I found a solution and signed up to several years' subscription to Anima app, which allows for prototypes to be converted into React front end code. This code can, in the future, be hosted on a server, subject to receipt of additional funding to address any remaining usability and asset design quality issues, and be made available to all service providers, who receive the link.

6. RESULTS

This chapter will present the results that emanated from the three stages of user-centred design which resulted in four distinct datasets. Initial data was collected with four expert interviewees who worked with PwID. There were three subsequent data collection points with young adults with ID. Therefore, the four datasets in total to collate and analyse included:

- Stakeholder data,
- PwID empathy workshops data,
- Codesign workshop data with PwID,
- Lab sessions data using the *CyberSafe* prototype.

Braun and Clarke's (2022) reflective thematic analysis was employed to analyse all the data gathered. In each of the four datasets, various themes emerged, as illustrated in Figure 43.

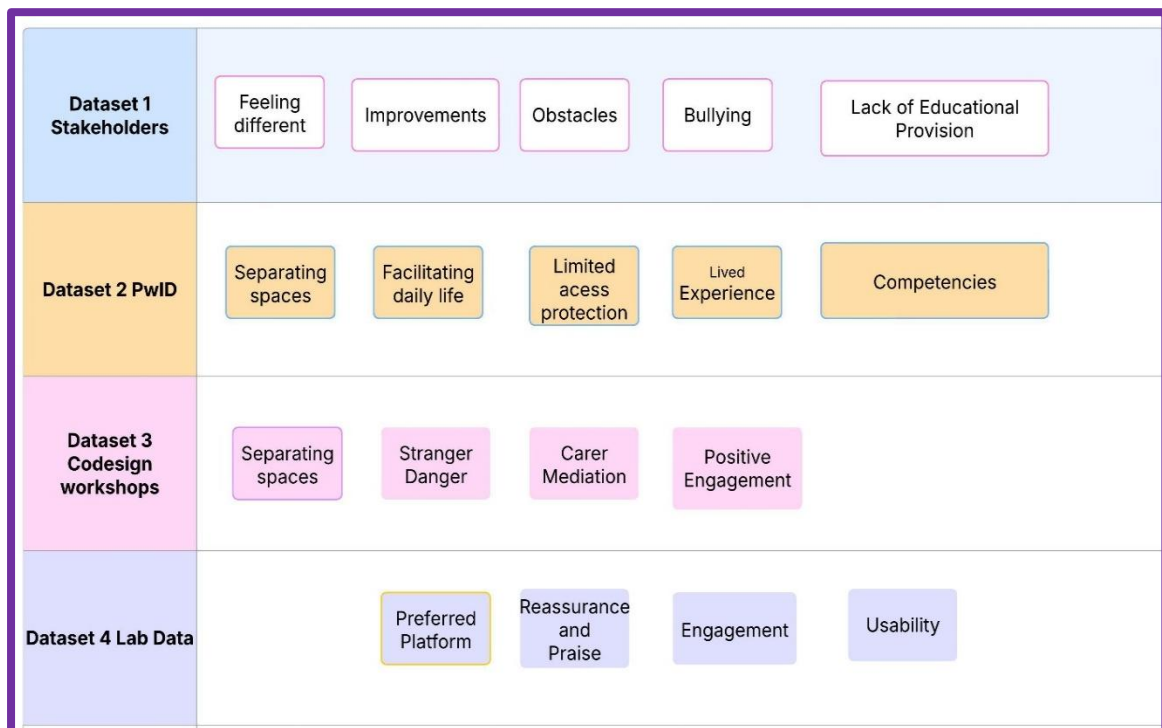


Figure 42 Themes generated across the four datasets

Some themes emerged in more than one dataset and were identified as meta-themes. Meta-theme analysis is a qualitative research method used to identify and analyse overarching themes across multiple studies or data sets (Cresswell and Poth, 2018). The first step of any meta-theme analysis is to inductively identify themes within each dataset (Wutich *et al.*, 2021). Each data set was reviewed to identify the main themes and subthemes that emerged. The themes from each dataset were then compared and synthesised to identify broader, overarching themes, known as meta-themes. These meta-themes represent commonalities or higher-order patterns that transcend individual datasets. The meta-themes, listed below, provide a more comprehensive understanding of the research questions by integrating findings from the multiple datasets:

Meta-theme 1 Internet enabled improvements

Meta-theme 2 Obstacles

Meta-theme 3 Identity cyberbullying

Meta-theme 4 Gaps in Educational Provision

Meta-Theme 5 Separating Spaces

Meta-theme 6 Support worker Mediation

Meta-theme 7 Engagement

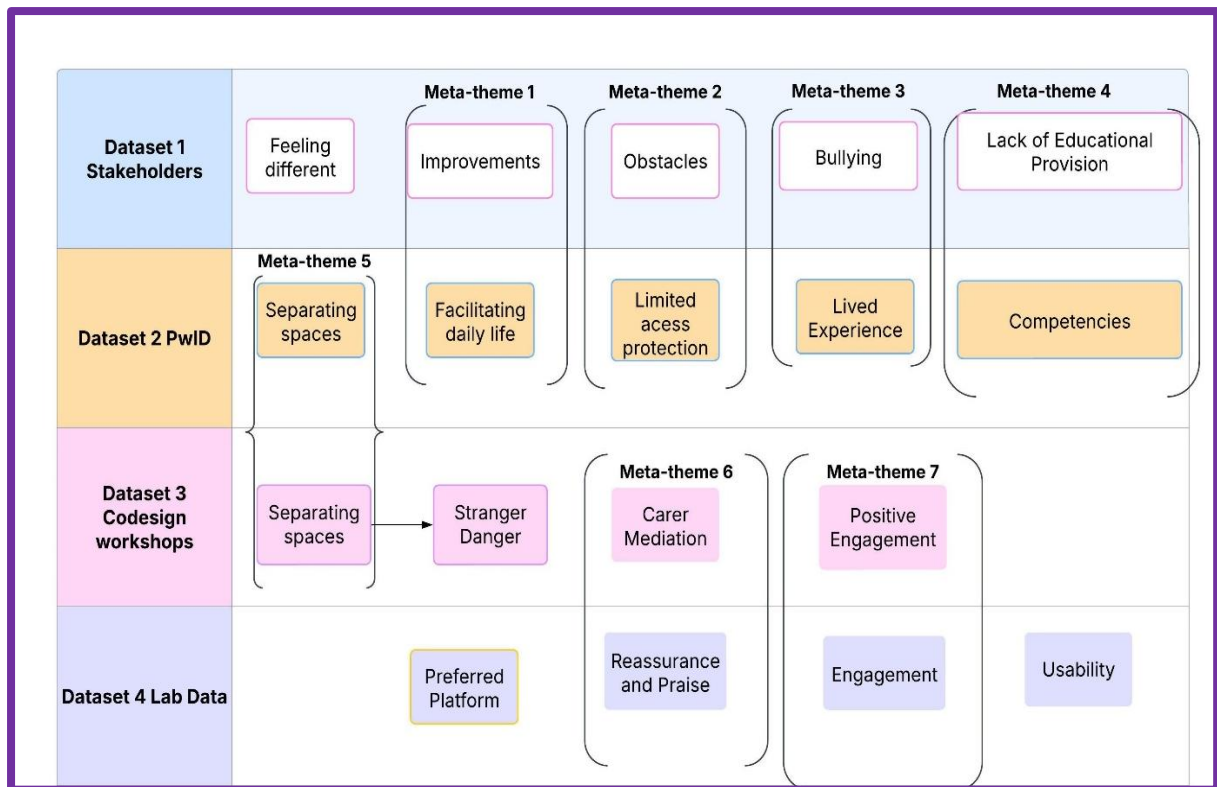


Figure 43 Meta-themes identified across the four datasets

As shown in Figure 44, Meta-theme 1 “Internet enabled improvements” was identified across Dataset 1 as the Improvements theme from Stakeholders and Dataset 2 Facilitating daily life theme from PwID. These two themes align and build on each other. These two similar or related themes from the first two datasets were merged into the higher-order category metatheme of Internet enabled Improvements, as a result of noticing recurring metaphors or language and shared concepts despite contextual differences. The same process occurred for:

- Meta-theme 2 Obstacles
- Meta-theme 3 Identity cyberbullying
- Meta-theme 4 Gaps in Educational Provision

As illustrated in Figure 44, Meta-Theme 5 Separating Spaces was identified across Dataset 2 from the PwID empathy workshops and from Dataset 3 PwID Codesign workshops and was related to the Stranger Danger theme from PwID, also identified in the PwID

Codesign workshop dataset. Similarly, Metatheme 6 Support Worker Mediation and Meta-theme 7 Engagement go beyond surface-level observations and are abstract enough to capture shared meanings across datasets 3 and 4 from PwID codesign workshops and lab sessions and emerged from the original data. In the discussion chapter, these meta-themes will be interpreted to draw broader conclusions about the research topic. The discussion chapter will look for patterns, relationships, and connections among these meta-themes and will discuss their implications for this field of study.

The most prevalent theme generated from the empathy workshops with PwID was how internet and mobile app usage can facilitate and improve their daily lives. This represents a meta-theme, which was first echoed in the four expert stakeholder interviews and survey data with 14 support workers.

6.1 Meta-theme 1--Internet enabled improvements

The theme of *'Internet enabled improvements'* emerged from the first two datasets i.e., interviews and surveys with stakeholders and the empathy workshops with PwID. In the first dataset from four interviews with expert stakeholders (service policy maker, PwID researcher, PwID advocate, senior instructor), the meta-theme *'Internet enabled improvement'* was generated using repeated references to how the internet has enabled improvements for the lives of PwID, their families and their support workers. In the interviews and survey data from 14 support workers, the codes generated included skill acquisition, alternative expression, connection, information retrieval, independence, and entertainment. The first subtheme *'Improving oneself'* explores how the internet facilitates skill acquisition while the third subtheme *'Living my own life'* explores how the internet increases autonomy and decreases support worker pressure.

The first subtheme identified in this analysis is *'Improving oneself'*. Skill acquisition can be argued to be one of the biggest benefits for PwID when they are online. Throughout the datasets, it becomes clear how the internet *"builds their capacity to learn new skills and around new technology"* (EP3). Respondents indicated improvements in a diverse range of skills that were otherwise unobtainable without the internet. These include navigation,

communication, hobbies, shopping, banking and life skills. As a result of these increased competencies, PwID have more autonomy, which takes pressure off carers and family as the need for assistance decreases. This results in improved quality of life for all. The second subtheme *'increased/easier communication'* explores how the internet facilitates alternative communications modes. Expert participant 1 remarked how *"anyone who doesn't have good literacy skills can actually do voice recordings and then they can communicate that way"* (EP1). Stakeholders pointed out how internet access can also allow PwID to free themselves of their disability and associated stigma: *"they all struggle with the same things. The stigma, they felt different, they're inadequate"* (EP3).

The *CyberSafe* application utilised self-instructional material as much as possible to facilitate autonomy. Respondents commented on how the internet creates an environment in which users can connect with their family, support workers, and peers which otherwise was impossible, especially during the Covid pandemic. *"They can't go meet them. So being online means they can get in contact with them"* (EP4). The communication apps on phones enable PwID to keep in contact with different peers and disability groups. The accessible technology interfaces facilitate alternative expression (e.g., voice notes as opposed to text) and can search for what they want to communicate. Therefore, the technology allows users to overcome the communication difficulties of their disability. The internet can facilitate a safe environment for PwID to vent frustrations or concerns which they may not want to discuss with their family.

The third subtheme identified by expert stakeholders *"Living my own life"* was generated from the codes: *'entertainment'* *'informational retrieval'* and *'independence'*. Respondents indicated that entertainment is not only beneficial to PwID but to parents as well. Since PwID are occupied using the technology, this provides family members with a break from supervision. Informational retrieval allows users to engage with whatever interests them as *"they are searching for something they like, music or cars and that"* (EP2) or *"they can see other services and what they're doing."* (EP4). All four expert stakeholders highlighted that independence is strongly increased as PwID rely on apps and internet resources to navigate and learn whatever they need to know, thus reducing their reliance on others. This also results in family and support workers feeling more assured as they have experienced the

benefits these apps provide for independence and autonomy. It is important to be mindful that PwID cannot be monitored constantly and can access the internet in cafes or from a friend’s house. Therefore, it is essential to teach internet safety tips to increase PwID autonomy and independence, protecting them for the future so that guardians and parents are more assured. These findings illustrate how digital technologies can extend personal agency for PwID, particularly where interfaces allow alternative modes of expression and self-directed learning. However, this agency is not inherent to the technology itself, but emerges through specific design affordances and social supports, reflecting a socially shaped rather than being an inherent property of the technology itself (Williams and Edge, 1996; Mackenzie, 2001). From a social justice perspective, the ability of PwID to use mainstream platforms in ways similar to their neurotypical peers contributes to social inclusion and recognition, supporting participation in everyday social, cultural, and communicative practices (Fraser, 2000; Nussbaum, 2006).

6.1.1 PwID data

This first meta-theme of *Internet enabled improvements* via the theme *Technology facilitating daily life* was also generated from the data findings in the empathy workshops with PwID, which show repeated references to app use among PwID. As illustrated, in the first empathy workshop, conducted with 12 participants in May 2022, computer, phone and app use is an integral part of lives for PwID.

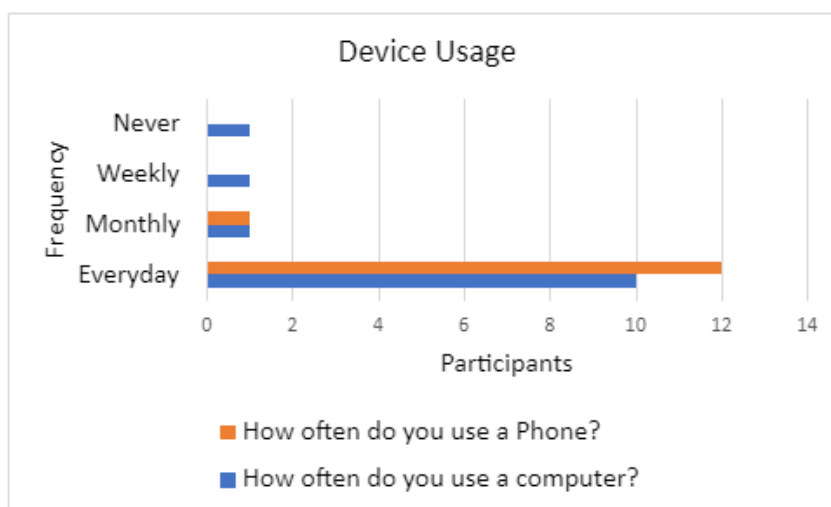


Figure 44 Device Usage Empathy Workshop

In the second empathy workshop, which was conducted one year later in 2023 with 11 new participants, there were repeated references to internet and app use among PwID. Participants were queried about iPad usage in the final workshop.

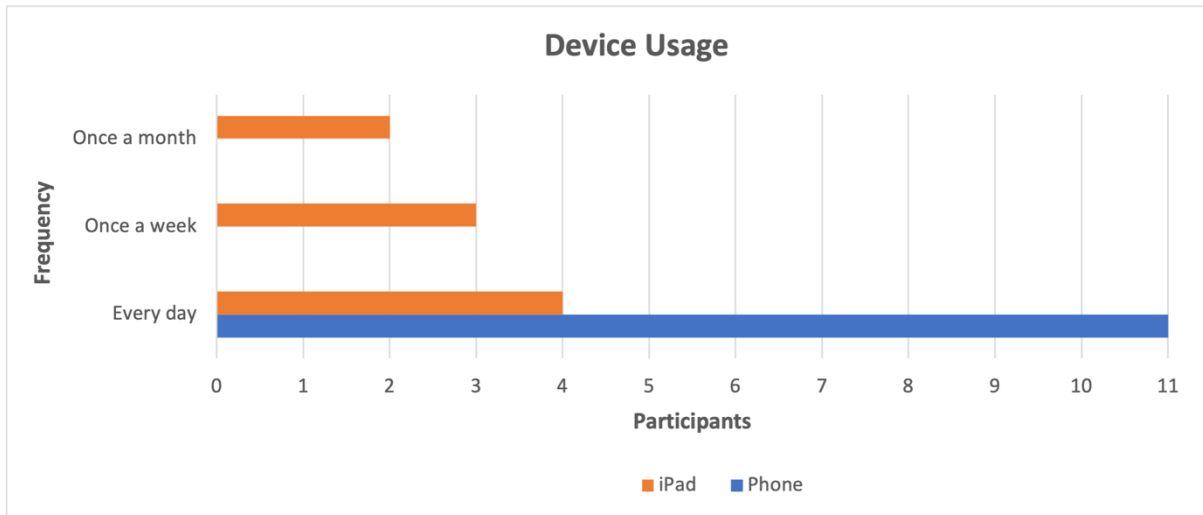


Figure 45 Device Usage Empathy Workshop 2

In the first empathy workshop with 12 PwID (May 2022), many participants used various applications every day to facilitate communication with support workers, engage with hobbies and maintain friendships.

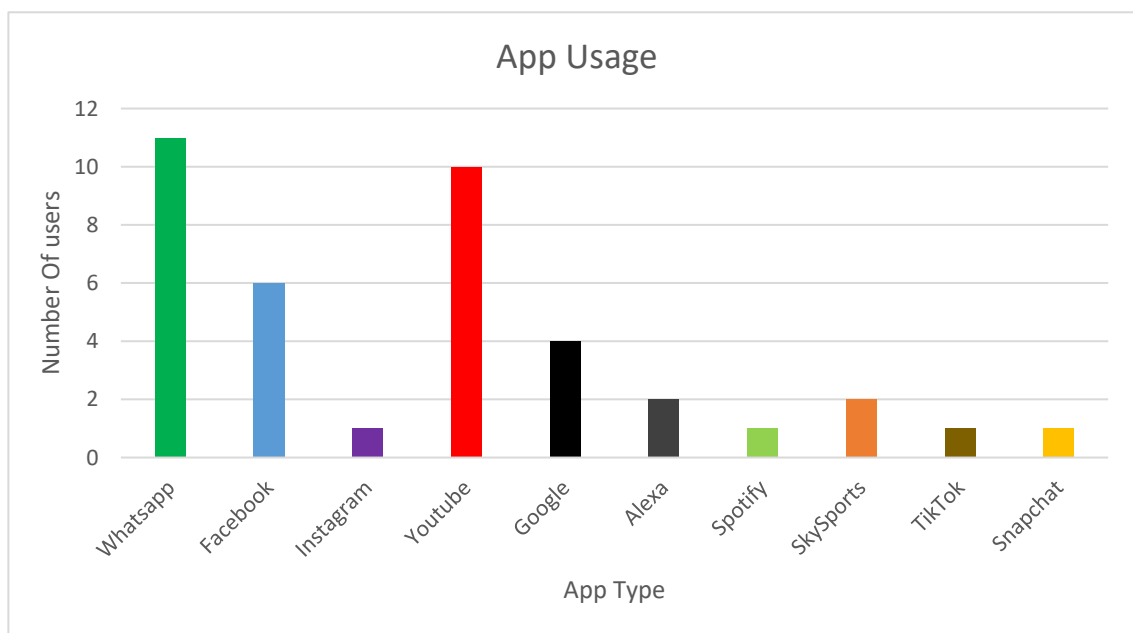


Figure 46 App Usage Empathy Workshop Round 1 (2022)

In the second round of empathy workshop with 11 new participants in spring 2023, there was a larger variety of apps used to facilitate communication with family and support workers, to maintain friendships and to participate in hobbies, particularly playing games.

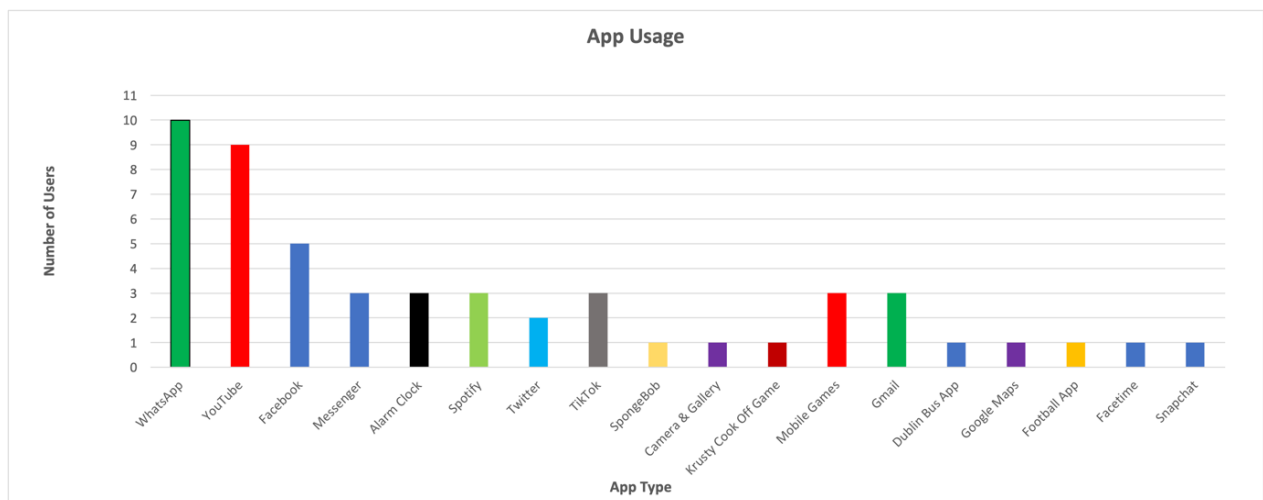


Figure 47 App Usage Empathy Workshop Round 2(2023)

When asked in the empathy workshop about remembering passwords, 75% of the participants in both empathy workshops reported that they logged into the apps and find it easy to remember the login passwords for the apps they use. Similar to the first empathy workshop data, the main apps used were WhatsApp and YouTube on their phones and to a much lesser extent, Facebook. WhatsApp appears to be the most frequently used application for communication among PwID as one participant said that they do *“group chats with (Name redacted) just to have chats, just to keep it going, just to keep the friendship going”* and that she *“uses voice messages”* (PwID1).

Participants also use WhatsApp to send photographs and music and film links as *“one day it was James Bond, another day it was Ms. Marvel.”* (PwID 2). Due to WhatsApp’s ability to communicate in various forms, it is extremely accessible for PwID. Both WhatsApp and Snapchat afford the opportunity to maintain friendships and develop relationships within their community, as one participant observed *“My friend and my support worker are on Snapchat”* (PwID 4). Facebook, Messenger, Alarm Clock, Spotify, Tik Tok, Mobile Games and Gmail apps were used most often on the participants’ phones. These applications helped participants facilitate hobbies and interests, with three participants reporting that they use Spotify to listen to music. Other applications that were less frequent include

Snapchat, SpongeBob, Camera & Gallery, Dublin Bus, Google Maps, Football App and Facetime App with one participant reporting the use of a sports app to keep up with their favourite team such as *“Sky sports for all the premiership results”* (PwID3).

Similar to WhatsApp and Facebook, Snapchat, Facetime and TikTok allow users to explore hobbies, maintain communication and facilitate relationships as one participant remarked *“My friend and my carer are on Snapchat”* (PwID7). Similar to Youtube, Football App and Krusty Cook Off games allow users to explore hobbies. Three participants reported that TikTok and Alexa allow them to explore hobbies, maintain communication and facilitate relationships. However, they are far less utilised compared to WhatsApp and YouTube and appear to be favoured by those who are already tech savvy. The codes *Friends*, *Girlfriend*, *Boyfriend* and *Every Day* appeared in the dataset when talking about Whatsapp facilitating communication. This multimodality and ability to communicate in various forms may explain in part why WhatsApp is so popular among PwID. Furthermore, the use of these applications can make PwID feel more like their peers and family, who are using these applications.

6.2 Meta-theme 2—Obstacles

The second meta-theme *‘Obstacles’* reflects the various barriers to internet safety and use. This theme which emerged from the expert stakeholder interviews, comprised the codes *‘barriers’*, *‘finance’*, *‘risk’*, *‘fear’*, and *‘parental control’*. A variety of obstacles hinder PwID from both accessing and interacting online. The first subtheme identified in the stakeholder data analysis is *‘online access’*. This subtheme explores how PwID are adjusting to increased internet use. Experts were concerned about PwID and online access and *“the ability to use it, they really need to be shown how to use it”* (EP2) or *“it’s the fear of a lot of those people who don’t know how to set their tablet up and stuff”* (EP4).

The other most salient barrier for PwID is the reading challenge; this hinders internet use as *“the internet is very much aimed at readers”* (EP1, EP3). Experts highlighted those users would not be able to comprehend the internet. Furthermore, users with moderate literacy may be unable to type in passwords, thus preventing them from using any internet site that requires an account, e.g. *“Say someone’s illiterate trying to get them to type in a password is extremely difficult”* (EP1). In one case, a PwID had spent a substantial financial

sum on an iPad but did not possess the training to use it. It was a *“brilliant piece of equipment but she didn't have the internet and she hadn't got a clue how to use it.”* (EP3). This barrier is caused in part by the rapid evolution of various technologies and apps. There appear to be so many different apps that both service providers and guardians struggle with giving the PwID appropriate education around them all. Not only do PwID struggle with technology, but expert respondents also indicated that this applies to guardians as well. This means that services *“have no idea where to base ourselves on so it's just like where do you start”* (EP1).

Another subtheme barrier facing users is *‘finance’*. Expert stakeholders indicated that many PwID did not use or need the internet before the pandemic. PwID may lack broadband resulting in the need to use hotspots, which can cause unforeseen financial costs. PwID, who do have internet-accessible phones, may only have basic packages that do not include internet access or maybe live in an area with a bad live connection. Furthermore, expert participant three remarked that *“obviously poverty is an issue, like a high number of people already wouldn't have employment”* (EP3). This puts financial pressure lands on organisations and parents to buy the necessary equipment, which facilitates internet access. Expert participant 1 noted that *“voice recognition software can also struggle to understand the voices of PwID”*, which can inhibit alternative expression and connection (EP1).

The second subtheme identified in this dataset is *‘tension’*, which manifested itself in two ways i.e., over parental protection and online risk aversion. Parents and guardians can be overly protective, seeing their offspring as an *“everlasting child”* (EP2), limiting what users can access, if at all. One expert stakeholder remarked that *“the parents just see them as the everlasting child. They think that they should stop them and only let them do what they want them to do.”* (EP2). Expert stakeholders argued that treating PwID differently solely due to their condition, while well intentioned, helps to perpetrate internet inequality for these individuals and can limit their ability to develop skills and experience the online world like everybody else. They said that *“if we're not allowed that freedom, then we're never going to learn and we're always going to be ‘protecting’ as opposed to empowering”* (EP3). They emphasised that *“the person is an adult and he has got the right really to look at*

whatever he wants.” (EP2). On the other hand, parents can be under protective, not taking internet use or cyberbullying seriously. This can be due to feeling sorry for the bully who may also have an ID, or parents being too elderly to understand the internet. *“They didn’t take it serious at the time you know, and the mum is so regretful now” (EP4).* Regardless, this can result in cyberbullying and complications that can affect far into the future such as losing a job and *“needing prescription medication” (EP3)* to handle the upset caused by the cyberbullying. Similar to parental control, the same tension trend was observed with fear. Stakeholder respondents indicated that many PwID are still afraid of the internet. Expert stakeholders expressed concern that *“you don’t want to frighten them into thinking this isn’t good at all because then they might think it’s better for them not to have access at all” (EP1).* Fear and a lack of understanding can manifest into PwID thinking they cannot use any internet features, even if they are safe. For example, one PwID thought predators on Facebook meant that she could not use Whatsapp. Another user was fearful that his money would be taken from his account if he used Facebook. Self-imposed digital exclusion occurred for this person with ID who did not use social media, though he used his computer regularly. He opted out of social media due to worry and fears around possible risks. Other expert stakeholders also described similar online concerns, namely having personal, social and financial information and accounts hacked or stolen, computer safety compromised from viruses, and privacy breaches, which led, in some accounts, to PwID reluctance to engage with activities online. However, some PwID do not view the internet as dangerous at all and are unaware of risks online, which is equally problematic, as *“it just would never enter their heads there might be a danger” (EP2).*

6.2.1 PwID data

The ‘*Obstacles*’ meta-theme also emerged from both rounds of empathy workshops with PwID. This meta-theme can be seen in the lack of access to devices. While there were repeated references to the fact that although users are able to use devices and applications, their accessibility is limited by others, either in withholding devices or from a lack of WiFi to access the internet. One young PwID participant remarked how she spent time *“on my mum’s phone, I don’t have a phone” (PwID 2).* Another said *“that they are not (on Facebook) but my mum and dad is” (PwID 1).* While this *Obstacles* theme was the least prevalent of all

the themes generated from the PwID empathy workshop dataset, it highlights an important barrier for PwID to access the internet. Even though parents are aware of how beneficial these technologies can be, some were not allowing their use. One support worker (SW) remarked that *“participant one would use her mum’s phone... you can talk to your friends using WhatsApp. You just use your mum’s phone just yet. Because you’re still learning how to be safe on phones, isn’t that it?”* (SW1).

Other PwID were vocal about their lack of access to the internet using Wifi. *“We don’t have wifi in the sports hall so we can’t do anything. Staff are on the computers but in the sports hall, we can’t use them”* (PwID 7). This is interesting as there was no reference to mobile data. It seems to infer that that some of the participants believed simply that their only way to access the internet is through Wifi or they did not have a package on their phones for mobile data. This led to feelings of frustration as PwID can see staff members in a day service using the Wifi, yet it is inaccessible to them. It appears that family and staff members may withhold device and internet access as a means of safeguarding PwID, despite the frustration and sense of exclusion this can generate for PwID. The obstacles identified across the first two datasets demonstrate that digital exclusion is produced not only through individual impairments but through social, economic, and institutional power relations that mediate access to devices, connectivity, and digital literacy, which aligns with SST theory (Warschauer, 2003; Selwyn, 2010). From a social justice perspective, practices of parental control, safeguarding, and fear-based restriction illustrate how power is exercised over PwID’s digital participation, often limiting opportunities for skill development and independent engagement despite intentions of protection (Winner, 1980; Goggin and Newell, 2003).

6.3 Meta-theme 3--Identity bullying (bullying because of who they are)

The third meta-theme “Identity Bullying” was generated also in the empathy workshops with PwID. This theme illustrates how PwID are victims of bullying in all forms, from physical and verbal bullying to online cyberbullying. Participants were first asked about their experience of physical or face-to-face bullying. Physical bullying was reported as one participant recalled that *“Two boys pushed me”* (PwID1). Another participant reported verbal bullying when he recalled that *“Yeah, I got bullied, one of my best friends got bullied,*

one of my friends shouted across the road to my best friend (PwID3). Another participant described verbal bullying as: *“It’s when uhm it’s when people tell tales. They can hurt you” (PwID5).* Stakeholder respondents indicated how PwID are easily identifiable online due to the nature of their disability, due to their appearance or verbal expressions and limitations in comprehension when they communicate as *“you can tell straight away that this is somebody that has an intellectual disability” (EP1).* Expert respondents in their interviews explained that the internet can be far more hostile to PwID and that their lived experience can be drastically different from that of a neurotypical person. Lines can become blurred for the user as *“they struggle to identify sarcasm” (EP4).* This results in them being unaware that they have become an object of ridicule as *“they’re putting up posts, look at what he’s doing or they’re making smart comments that you know is sarcastic” (EP4).* In some cases, cyberbullying can have detrimental effects on users’ mental health resulting in the need for prescription medication (EP3).

Cyberbullying is such a widespread problem; some PwID can be convinced bullying is inevitable as a consequence of who they are as opposed to being an issue of inequality. *“They need to feel that bullying is not part and parcel of having ID. I have heard over the years it’s never going to stop; we’re always going to be bullied because we have an ID” (EP3).* PwID struggle to understand who *“real”* friends are, with many adding strangers or having *“hundreds of thousands of friends” (EP2).* Since users typically have small friend groups, they may tolerate bullying as they think the bully is their friend. However, peer-to-peer bullying was identified as the most common form as *“people kind of picking on each other within that group” (EP1).* Further risks include misconstruing staff relationships as friendship relationships online (EP4). PwID who do not understand the rules of social media, are the most vulnerable to predators. Respondents indicated that this lack of understanding around interacting online (i.e., netiquette) as a main concern. This can cause issues as *“PwID may give out sensitive personal information” (EP3).* PwID struggle to understand using various websites and apps in both their interactions and various social rules. For interaction, all stakeholder respondents indicated the distinct need for PwID and support worker training. The data from the empathy workshops illustrates how PwID are victims of online cyberbullying. The experience of bullying and cyberbullying impacted their emotional well-being. Individuals who opened up in the empathy workshops about their personal

experiences with cyberbullying expressed some of the negative effects of victimisation. They expressed feelings of sadness and hurt.

PwID1: "I got bullied on my WhatsApp. I got mean text messages, that's not nice"

PwID1: "It frightens me"

PwID2: "They annoy me, sad"

PwID4: "Outside I saw it and I was bullied and it hurt my feelings".

Although the bullying described by some participants happened some time ago, it was still affecting them years later. From an ethical perspective in the data gathering workshops, I witnessed one participant shedding tears as a coping mechanism to avoid excessive sadness and other upsetting emotions. I observed that acknowledging the negative effect of the bullying and the shedding of tears was a therapeutic and healing experience. Support staff cared for affected participants. One participant left the room, for a number of minutes, accompanied by a support worker to recover. After this participant returned to the workshop, I observed that the releasing of emotions in the form of tears acted as a therapeutic intervention (Vingerhoets and Cornelius, 2001), through which the participant maintained emotional balance of mind and body. Surprisingly, the *CyberSafe* results observed no data on inappropriate image sharing/sexting, eventhough the question was asked whether anyone had received inappropriate images, in both rounds of empathy workshops.

Participants reported being frightened by bullies on games platforms and were not sure how to report bullies when playing video games. One participant reported that: "Bullies are bold and angry" (PwID5). Some of the participants mentioned playing console games, namely the Nintendo Switch. A support worker, present in the empathy workshop, asked if anyone knew how to block someone on these platforms, which they did not. Participants communicated strong advice, which they would give a friend who was experiencing bullying or cyberbullying in the form of "go and tell someone you trust" (PwID4). Some individuals suggested seeking support from others including parents, key workers and friends. "Sometimes, I forward mean messages, I tell my keyworker and then my keyworker tells other keyworkers" (PwID7). A number of participants with ID recommended ignoring the

bullies or walking away. One participant indicated that if they were being cyberbullied online, they would not tell their support worker. His reasoning was that ignoring the bully was enough. Interestingly, no one suggested standing up for oneself. Experiences of identity-based bullying reveal how online environments can reproduce existing social inequalities, where PwID are targeted due to visible markers of difference and reduced capacity to interpret social cues, reflecting broader patterns of symbolic power and misrecognition (Fraser, 2000). These findings highlight how digital spaces are not neutral but socially stratified, with PwID experiencing disproportionate exposure to harm that undermines their sense of belonging and emotional well-being (D’Cruz *et al.*, 2016). Drawing on social shaping of technology theory, such disparities reflect the ways in which digital technologies are socially constructed through political and cultural forces that systematically marginalise PwID, limiting their equitable participation in digital society (Williams and Edge, 1996; Wajcman, 2002).

6.4 Meta-theme 4– Gaps in Educational Provision

This meta-theme describes gaps in educational provision, identified by expert respondents, which are needed to create a safer more digitally accessible internet. Expert stakeholders are *“not aware of many educational resources there for them”* (EP2). Expert respondents also indicated the lack of understanding around interacting online as the main risk concern. For interaction, all expert respondents indicated the distinct *“need for PwID and support worker education”* (EP1, EP3, and EP4). Not only do users struggle with technology, but respondents indicated that this applies to support workers as well. There appears to be so many different apps and websites that both service providers and support workers struggle with providing appropriate education about them all, stating that *“There is a need to train users around every app individually”* (EP1).

6.4.1 Financial transactions

Another issue was misunderstanding financial transactions. PwID appear to be unaware of how financial transactions work, leading them to pay out large sums of money for various apps and subscription models. Strategies for development of financial and digital management skills were not evident. These constraints illustrate how digital participation is

unevenly distributed along socio-economic lines, reinforcing broader patterns of inequality (Warschauer, 2003). From a social justice perspective, such disparities represent structural barriers that limit PwID's right to participate fully in digital society.

"Buying an app which isn't a physical thing, they're not handing their card over, a lot of them don't even know" (EP4).

6.4.2 Netiquette

PwID further struggle to understand various apps in terms of the interaction and associate netiquette (i.e., various social rules). There was consensus among expert interviewees about the ability of PwID to access the online environment being hindered by a lack of education about cybersafety. These preliminary findings from the expert stakeholder interview data highlight the need for a dedicated course on cybersafety. The *CyberSafe* application is one such resource to cover modules on rules of social media, personal information sharing, whom one can trust, handling subscription models and financial scams.

6.4.3 Inaccessible digital content

Expert interviewees stated that basic human rights are being ignored in terms of inaccessible digital content. The biggest suggestion voiced by respondents is making resources more accessible, meaning presentation of content as *"making everything more accessible would be a huge help" (EP1)*. One respondent noted that *"games are the best way for users to learn" (EP2)*. All respondents indicated not only a lack of current resources but the issue of resources not being digitally accessible to those with ID. Respondents expressed the need for more representation of PwID in educational resources on cybersafety, which provided the impetus for the *CyberSafe* educational application. This combined with *"a clear small step-by-step process containing multiple modalities (video, audio, graphics and limited text), greatly increases accessibility for the user as there are alternative ways to learn which is not limited by their disability" (EP4)*.

6.4.4 Representative real-life examples

Expert participants echoed a strong desire for representative real-life examples to help solidify information. Real-life examples allow users to apply new skills more easily to real-life scenarios. However, it should be noted that *“everyone is different” (EP1)* and this can lead to design challenges that try to accommodate everyone. Expert respondents suggested there was a need to train users around every app individually, even though the information can be similar. Simplicity appears to be key, with respondents indicating clear small sections, possibly put into user's own words are what is most effective in teaching internet safety. As one respondent commented, *“less is more” (EP2)*. Most bullying appears to occur in peer groups and while users can identify when they are the victim, they struggle to understand when they are the bully themselves. There appears to be a lack of *‘safe spaces’* whereby users can voice their concerns around bullying and get help. One expert respondent indicated PwID feel they must contact gardai to resolve bullying. The lack of accessible, representative cybersafety education identified by stakeholders reflects an injustice in digital learning resources, limiting PwID’s opportunity to develop the capabilities required for safe and meaningful online participation (Sen, 1999; Nussbaum, 2006). From a social shaping perspective, these gaps demonstrate how institutional priorities and design norms privilege neurotypical users, reinforcing exclusion through the absence of appropriate resources rather than through technology alone (Williams and Edge, 1996; Selwyn, 2010).

6.4.5 PwID data

The fourth meta-theme of *‘Gaps in Educational Provision’* was generated also in the empathy workshops with PwID. Participants were asked firstly about their experience of cyberbullying. The first subtheme of *‘Awareness’* was evident in the fact that some participants were informed on what to do if they encountered bullies in the online space, sharing their experience on what they did to resolve the issue

“I blocked them from my WhatsApp and deleted their phone number” (PwID1).

“I just stop the call straight away” (PwID2).

“Block them on Facebook or twitter” (PwID2).

“There was a few numbers I didn’t know and I was checking with my support worker and we

managed to take them off my phone. I struggled that time and I was like I'm going to go to (support worker's name) and just get this problem sorted out" (PwID3).

However, the subtheme 'Lack of Knowledge' emerged when I asked about privacy settings. Some users did not know what steps to take to block people, which highlights the need for more education around this topic

"I dunno how to block, I don't know." (PwID5)

"I don't know how to remove, block or report someone" (PwID6)

PwID participants asked for education on privacy settings in apps. Furthermore, some participants were knowledgeable about online scams and what to do if a scammer tried to contact them. The answer was to hang up or finish the call. Some participants, however, clearly showed the need for training and education on privacy settings.

Sub theme Algospeak

'Algospeak' refers to coded language and euphemisms used on social media platforms, particularly on TikTok, to avoid having content removed or filtered by an algorithm. Due to strict content moderation on TikTok, a form of doublespeak, sometimes referred to as 'algospeak', has arisen as creators attempt to avoid penalty. Examples of algospeak include:

unalived = killed; accountant = sex worker; keep yourself safe = kill yourself

When telling an anecdote, Participant 2 referred to suicide by saying "the 'S' thing".

"There was a TikTok star and they were bullied and all and they ended up taking - I won't say it - but they ended up doing the 'S' thing" (PwID2)

The fact that this paralanguage has entered the participant's lexicon may indicate significant usage of the app. This illustrates how up to speed and embedded some PwID are in contemporary culture, maybe at times on certain elements more so than the support workers. It indicates also that the participant engages with, and understands the context of content of a serious nature on the platform. PwID 2 was aware of Instagram's "block any future accounts this person may create" feature and correctly stated "That's a new thing they brought in because two footballers were being abused - after they missed a penalty,

they were getting racist abuse - so Instagram took action about it.” This participant was very aware not only of the apps and their content but also of business news relating to them.

6.5 Meta-theme 5—Separating Spaces

The fifth meta-theme theme reflects the PwID perspective and difficulty in differentiating between the physical and the cyberworld. This meta-theme emerged from both the empathy and co-design workshop data as shown in Figure 49. While this difficulty in differentiating between the physical and the cyberworld was restricted to some users, it is evident in how most participants struggled with the concept of not sharing passwords. They struggled with the difference between real life and online life and people pretending to be someone else.

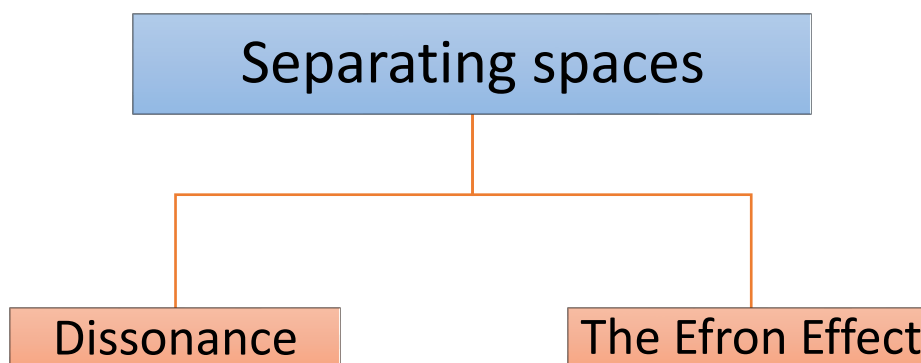


Figure 48 Separating Spaces theme with subthemes

Confusion emerged in the empathy workshops surrounding what to do if being cyberbullied. One participant indicated how they would “ring the cops” if being cyberbullied. Another gave advice on how to stay safe in the real world like “walk away from a bully”. This illustrated the complex nature of describing a non-physical space to PwID. It appears as if some PwID could not differentiate between the physical and cyber worlds. This dissonance was demonstrated in the comment “Don’t go out in the dark, don’t be on your own” (PwID1). When I asked: “Have you ever checked privacy settings on your device”, one participant responded: “I go to my room” (PwID3). Despite being fully aware of what they should do in the real world, there was confusion and lack of clarity on what to do when in an online space. One participant did not fully realise the danger of sharing passwords and was

giddily explaining how he shared it before indicating his view that it is ok to do so (PwID1). One user could not understand that someone might be impersonating their friend online and that it was not actually them (PwID1). I asked: "Suppose somebody messaged you and pretended they were your friend Ciara (not real name), would you know how to block them or stop them?" The reply was "I don't think so. Ciara is my family" (PwID1). This again highlights the difficulty some PwID may experience in separating a physical and digital space.

An interesting development was how some participants, who may know never to accept a friend request from someone whom they did not know, became confused when their favourite celebrity was mentioned. This led to the subtheme called '*The Efron Effect*' being identified. It represented the difficulty encountered by PwID in understanding that people can pretend to be someone different online. Under the theme of '*Stranger Danger*', identified in the Co-design workshops, the same interesting subtheme was highlighted, called '*The Efron Effect*', which had emerged in the empathy workshop. '*The Efron Effect*', in the context of the data analysed, describes where someone "catfishes" another, by pretending to be a celebrity. Because the celebrity is familiar to them, the user may agree to allow contact. Catfishing is a form of profile plagiarism, where an individual has stolen the online identity of another person and is using it as his or her own social media identity (Williams, 2020). The targets for these types of dishonest schemes are generally older people, or very young people that follow an artist or celebrity and are active in their fandom community. There was much reflection by the researcher as to what the subtheme for this phenomenon should be called. Some initial thoughts were '*Catfishing*', '*False Celebrities*' and '*Friend or Foe*'. However, as Zac Efron, the film actor, had been discussed in the Co-design workshops, this became the name of the subtheme, under the main theme '*Stranger Danger*'. Users were confused that people can pretend to be someone else online. Under the *Efron Effect* subtheme identified in the Co-Design workshops, a code identified was '*Vulnerability*'. Individuals with ID are frequently isolated from social interactions as a precautionary measure. When referring to people with disabilities, the term "vulnerable person" is frequently used. Being labelled as a vulnerable person raises security concerns for those who care for them. The second code identified was '*Safeguarding*'. The classification of people with ID as vulnerable people necessitates safeguarding in daily care. This means that concerns about security and socialisation are

frequently monitored. This can result in restricted participation in social activities and concerns about the risks of living a fully independent life.

This PwID datasets from the empathy and co-design workshops revealed that PwID would readily accept a request from someone they admire, like the actor Zac Efron. However, this is highly personalised to each individual, as one celebrity may not be as influential as another. Therefore, users may reject one celebrity friend request but accept another they like.

G2S1 (Support worker 1): "Have you ever met Zac Efron?"

PwID6: "I haven't."

PwID1: "I haven't either."

G2S1: "In real life, have you ever met Zack?"

PwID1: "I haven't either."

G2S1: "No? So that's why you have to think."

PwID5: "This is going too far."

G2S2 (Support worker 2): "I think for number 4, it would be Mo Salah (currently a very famous Liverpool Football player).

"PwID1 and PwID3: "Johnny Sexton!" (Famous Irish rugby player)

R: "So we seem to be split, for some people would say yes, they would be, some people say no, he wouldn't be."

G2S2: I think if it was the right person there would be a lot more Yeses."

This subtheme has highlighted an interesting phenomenon among PwID i.e., the more they like a celebrity; the more likely they are to accept a friendship request from them. They experience difficulty with the concept of people pretending to be someone they are not (i.e a celebrity) online. Difficulties in distinguishing between physical and digital spaces underscore how prevailing interface metaphors and interaction paradigms are socially shaped around neurotypical norms, embedding exclusionary design assumptions that marginalise some PwID at the cognitive level (Norman, 2013; Williams and Edge, 1996). From an SST and social justice perspective, phenomena such as celebrity catfishing

demonstrate that vulnerability is not inherent to PwID but is instead socially produced through sociotechnical arrangements, where design choices, unequal access to digital literacy, and constrained opportunities for experiential learning online converge to systematically disadvantage certain users (Wajcman, 2002; Williams, 2020).

The associated theme of *Stranger Danger*, was also identified in the data from 14 support workers, who identified the threat, as PwID struggle to realise that not everyone is who they say they are. In order to gather more qualitative data focusing on threats, an open-ended question was included in the survey circulated to 14 support worker respondents. This gave them a chance to answer in their own words. Responses were long and detailed, revealing how passionate support worker respondents are about the topic of cybersafety and how eager they are to have their voices heard. Predators and vulnerability were identified as the main risks of online participation. There were also common trends when it came to threats identified online. Appropriate learning resources were identified and recognised as *“desperately needed in this area”*: One support worker commented how she delivers *“bespoke training to those with intellectual impairments - different learning abilities require different learning tools/resources - social stories, videos, power-points facilitated discussions, games”*. This comment influenced the various learning modalities provided in *CyberSafe*.

A summary of comments on threats identified by 14 support workers, in the online survey circulated to service providers, is shown in Table 19.

Table 19 Summary of comments on threats identified by 14 support workers.

Threats identified by 14 support workers
Cyberbullying
Being contacted by someone who could harm them
Sexual exploitation
Lack of understanding, being vulnerable
Vulnerability, not understanding what the consequences of their actions may lead to. That things can be shared on a public platform with real life consequences.
Being targeted as it can be obvious that they have an ID
Inappropriate exposure or oversharing of information plus data breaches
Talking to strangers
Information cannot be taken down
Cyberbullying, being vulnerable to people with bad intentions
Not having good support, people with intellectual impairments not having access to the Internet or not having access to IT training
Being vulnerable to catfishers, hackers etc
Bullying, harassment, exploitation Not realising that not everyone is who they say they are & striking up fake friendships & been discriminated against

6.5.1 Noteworthy additional themes identified across the first two datasets.

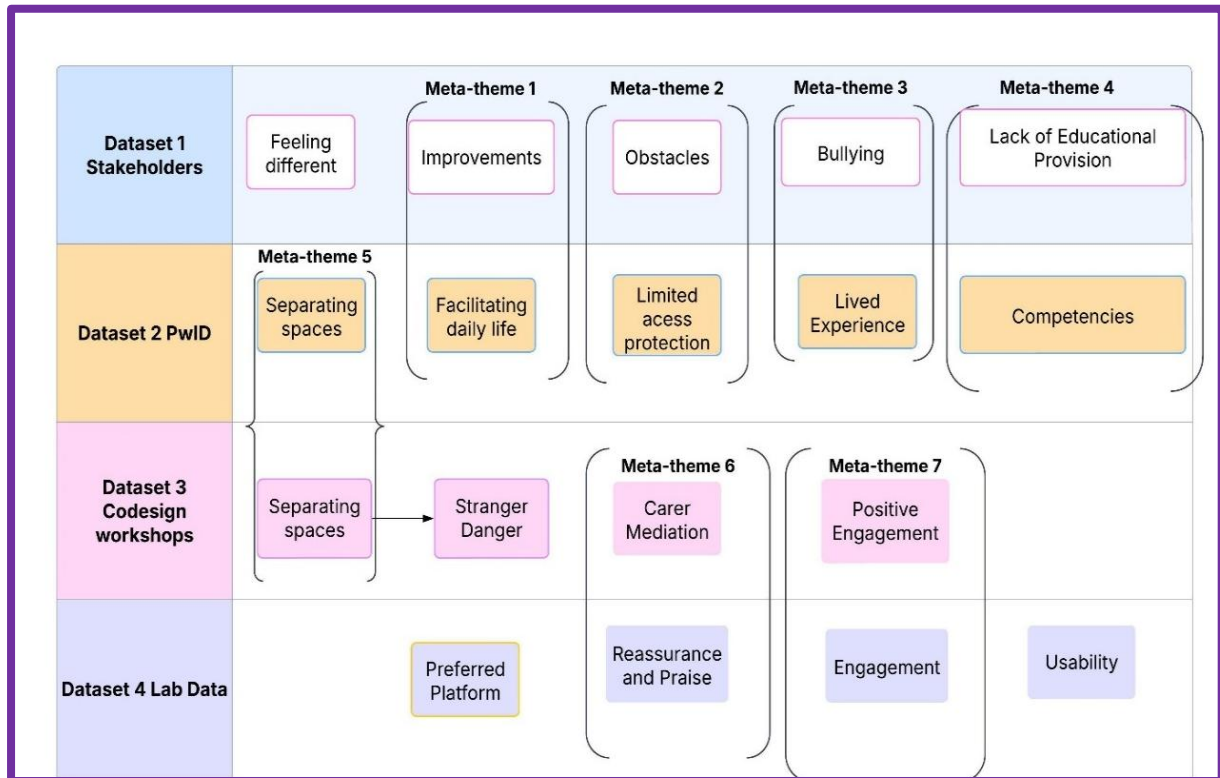


Figure 49 Themes and meta-themes generated across the four datasets

Figure 50 previously demonstrated how overarching themes across the four datasets were identified as meta-themes. The remaining other themes, which are worthy of discussion, will be reported separately. During data analysis of the four expert interviews in Dataset 1 (see Figure 50), five key themes (represented in white rectangles in diagram below) were constructed, which were related to the experience and expertise of the four expert stakeholders working in the ID sector. These five themes represent the overall narrative of dataset 1.

- Feeling different
- Internet enabled improvements
- Obstacles to internet use/safety
- Identity bullying (bullied because of who they are)
- Lack of Educational Provision.

Themes (2) to (5) from dataset 1 were then compared to themes identified in the other datasets and synthesised to identify broader, overarching themes, known as meta-themes across dataset 1 and dataset 2 (from the empathy workshop with PwID). The five meta-themes previously reported represent commonalities or higher-order patterns that emerged and transcend individual datasets. Only one theme from dataset 1 then remained alone, unattached to a meta-theme, and will now be reported i.e., *Feeling Different*.

6.5.2 Feeling different theme

The theme of '*Feeling different*' was generated in the expert interview dataset, using repeated references to the lack of equality and representation online for PwID. Codes for "*equality*", "*lack of representation*" and "*treated differently*" were generated with sample excerpts recorded. Internet usage among PwID appears to be a relatively new occurrence with respondents indicating how "*usage has increased rapidly*" (EP1). Respondents described how the impact of the COVID pandemic made online access essential for PwID. One expert interviewee remarked:

"I don't know where we'd have been in the lockdown without online access, I don't know how we would have managed, we never would have managed" (EP2).

In addition, echoed across all datasets was the importance and necessity of users being online (EP2, EP3, EP4) as "*anybody else who would be deemed an able-bodied person is on Instagram or is on Facebook*" (EP1). When online, PwID "*feel they're doing what their normal peers should be doing*" (EP4). This indicates the perception that without online participation, users will be "*left behind*" (EP2) and "*feeling different from everyone else*" (EP2). This can contribute to the already present stigma of feeling different due to having an ID (EP3). Furthermore, respondents indicated how society treats PwID differently. This can enhance the stigma and internet inequality which they experience surrounding their condition (EP3, EP2, EP3). One expert interviewee pointed out "*They all struggled with the same things. The stigma, they felt different, they're inadequate*" (EP1).



Figure 50 Theme 1 Feeling different

However, treating users differently solely due to their condition, *“while well intentioned, helps to perpetrate internet inequality for these users and can limit their ability to develop skills and experience the online world like everybody else”* (EP2). There needs to be equality and freedom for PwID as *“if we’re (EPs) not allowed that freedom, then we’re never going to learn and we’re always going to be ‘protecting’ as opposed to empowering”* (EP3). This lack of representation in an educational setting furthers the feeling of *“being different”* as PwID lack depictions of themselves in these *“real-life scenarios”* (EP4). Expert interviewees recommended me to *“include stories of their peers who have been through an experience like that.”* (EP2). When support workers do choose to limit what is available to PwID using safe mode options to protect them, further issues of representation occur.

“if it was just a safe mode, it would be a bit better but it says kids mode” (EP4).

This furthers highlights the feeling of being different as these safety extensions are aimed at children and are not representative of the ID population. To date, there are no technical tools to safeguard PwID online. The combination of inequality and lack of representation online results in PwID feeling different.

In summary, the findings of theme one *‘Feeling different’* can be summarised as the PwID experience of being vastly different from that of a neurotypical. Furthermore, PwID are at a far greater risk for bullying, cruel actions, and threats when online compared to neurotypicals. The lack of accessibility voiced by respondents indicate how unequal the

internet still is for PwID. All participants highlighted not only a lack of current educational resources but the issue of resources not being accessible to those with ID.

6.6 Noteworthy themes identified across the final two datasets

Research question four *which* set out to explore the usability, satisfaction and engagement issues when using the prototype, is broken down into three subcomponents:

- a) What usability interface challenges did users encounter when using the application?
- b) Did users engage with the application?
- c) Were users satisfied with the application?

6.6.1 Usability Theme

In the first lab sessions in 2022, four main themes were identified when participants interacted with the the first *CyberSafe* prototype.

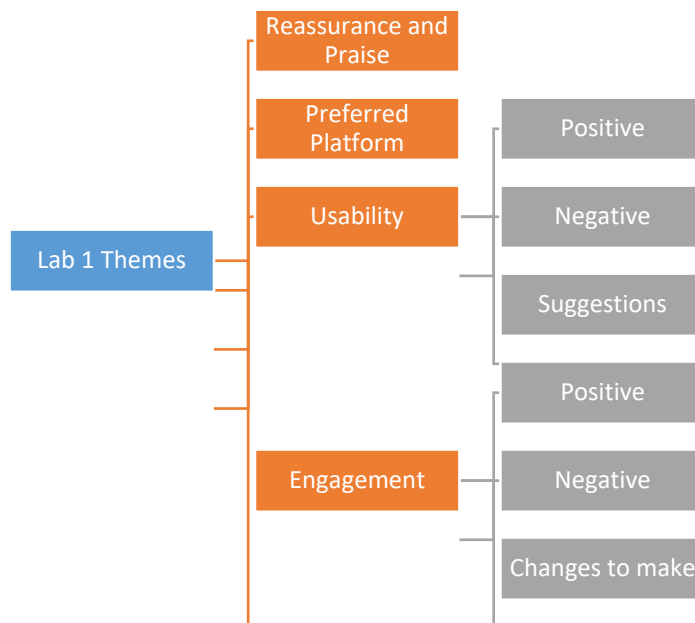


Figure 51 Lab Themes capture the overall story of the first Lab session dataset.

The four themes were generated from data triangulated from three sources:

- the associated lab Camtasia recordings of the prototype interactions

- the answers the 12 participants gave to the adapted system usability scale questionnaire (SUS) completed by participants with ID after interaction with *CyberSafe*
- the quotes from researcher observations during the lab sessions for both groups of six participants each.

Once again, Braun and Clarke’s (2006) six phases of thematic analysis were carried out on the first two datasets above. Sometimes, even when a code or theme was decided upon, it was later “tweaked” as another piece of data was noted which did not quite fit the prior code or theme. Phrases and pieces of texts were highlighted, and a comment attached to each with a particular code. A final table was drawn up with themes, sub-themes and codes. See Table 20 for summary of the themes and subthemes generated from the first phase lab session results.

Table 20 Lab Session Themes capture the overall story of the first lab dataset

Main Theme	Sub Themes	Points to note
Usability	<ul style="list-style-type: none"> ➤ Positive ➤ Negative ➤ Suggestions 	<ul style="list-style-type: none"> ➤ Findability ➤ Learnability ➤ Ease of use ➤ Likes ➤ Some difficulties navigating ➤ Trial and Error approach to Quiz ➤ Some system and user errors ➤ Video Play icon too small ➤ Audio needed for Quiz questions

Engagement	<ul style="list-style-type: none"> ➤ Positive ➤ Negative ➤ Changes to make 	<ul style="list-style-type: none"> ➤ Enjoyment ➤ Preferences expressed ➤ Positive college experience ➤ Frustration (just 1 incidence) ➤ Suggestions made
Reassurance and Praise	<ul style="list-style-type: none"> ➤ Help ➤ Reassurance 	<ul style="list-style-type: none"> ➤ Clarifications needed ➤ Hesitation
Preferred Platform	<ul style="list-style-type: none"> ➤ Laptop ➤ iPad ➤ Phone 	<ul style="list-style-type: none"> ➤ Preferred Laptop/desktop or iPad ➤ Not suitable for Phone

These first phase lab session results will now be reported in more detail. From the self-report Adapted System Usability Scale (SUS) feedback from the first lab participants, 92% (n = 11) found the application easy to use, with 7% (n=1) indicating it was “kind of” easy to use. Ease of use is a metric of satisfaction in using a product as established by one or more individuals using it.

Table 21 Codes related to the subtheme of Positive Usability

Subtheme	Codes	Definition	Sample quote
	Likes	User likes an element	RO Group 1 <i>P2: liked the flowers</i> RO Group 2 <i>People liked the maze</i>
Positive Usability	Findability	Ease of finding an element	CR Group 1 <i>P2: No issues finding</i> CR Group 2 <i>P6: Finds video</i>
	Learnability	Ease of Learning	RO Group 1 <i>P4 is exploring</i> CR Group 2 <i>P1: No issues with quiz</i>

From the data analysis of the Camtasia recordings (CR) during the lab session and the researcher observation (RO) data, positive and negative usability sub themes emerged. In terms of positive usability, 'Findability' and 'Learnability' were the two most prevalent codes in the data and code table. Learnability is defined as the ease and speed with which the users get familiar with the use of a new product. With high learnability, users can intuitively learn to use a product without training or manuals. Findability is defined as the ability of users to identify an appropriate Web site and navigate the pages of the site to discover and retrieve relevant information resources. The highest rated features of the app were a tie between the Quiz and videos (n=4). Users liked how easy the app was to use, its realistic images, what they learned, the colours and various questions (n =2). Most participants (66%, n = 8) were audible learners. This was followed by visual learning (40%, n = 6) and then reading (8.25%, n = 1).

Negative Usability

Table 22 Codes related to the subtheme of Negative usability.

SubTheme	Codes	Definition	Frequencies	Sample data
Negative Usability	Error	Where user or system occurs	N= 2	CR Group 1 P2: Tried to use home button but it didn't work CR Group 2 P5: Home button won't work
	Navigation	User has difficulty navigating	N=20	CR Group 1 P4: Gets stuck RO Group 2 P4: got lost with the badges
	Trial and Error	Participant kept trying options until they succeeded	N=10	CR Group 1 P6: Clicks wrong answer, immediately clicks other option CR Group 2 P6: immediately tries other option.

Some limited navigation issues were encountered e.g., playing the video button was not obvious for Task 1: Play the *'What is Cyberbullying'* video. The limited navigation issues are backed up by an analysis of the Camtasia keystroke recordings for all 12 participants in the first lab sessions in spring 2022. From the Camtasia recordings, interesting results emerged. The biggest surprise was how users had little issues in finding volume, play and pause buttons, despite the icons being small in the embedded video. However, most users assumed the video would play automatically, so there was a pause before clicking play. Furthermore, only four participants did not know how to enlarge and minimise the video. Nearly every participant found navigation easy, requiring little help and intuitively knowing what section to click next through trial and error, or if making a mistake, to use the back and home buttons. Interestingly, when completing the quiz and getting a wrong answer, some users instantly clicked the alternative answer, indicating they may not have read and comprehended the question, but instead navigated the quiz using trial and error. For one user who could not read, they needed help reading the questions and answers, but had no issues with navigation. From analysis of the self-reported SUS data, there was very little the 12 participants did not like. Some users (n=2) disliked the navigation. Other aspects that received low scores were reading, difficult topics and understanding information (n =1). Most participants indicated that there was nothing difficult to understand (75%, n = 9). One user found the pictures hard to understand, one found the words hard to understand and finally one user found the characters speaking hard to understand (8.25%, n =1).

6.6.2 Second phase Lab Session results

For the second lab iteration, November 2022, observations by the researcher were also recorded as well as participants' Camtasia keystrokes to observe the nine participants key strokes as they performed five tasks using *CyberSafe's* second iteration. From the data analysis of the Camtasia recordings during the lab session and the researcher observation data, positive and negative usability sub themes emerged. The nine participants reported strong positive usability scores in both the findability and navigation code observations in the Camtasia recordings. The summary of participant's responses in the adapted SUS measuring self-reported usability demonstrates that most of the participants found the application features "easy" or "very easy" to use.

Table 23 Ease of use scores

Ease of use	Very Easy	Easy	Hard	Very Hard
Cyberstalking video	4	3		2
Coin Game	2	4	1	2
Blocking video	2	2	3	2
Cyberstalking Quiz	3	4	1	1

Negative Usability

As students navigated to play the first cyberstalking video, a small usability issue was reported on the Animapp server version of the prototype at 4:28 minutes on the recording. The hotspot for each menu item was activated by clicking on the menu word rather than the graphic icon. This is a sensitivity issue in Anima, which surfaced, which does not exist in Adobe XD version. This accounts for most of the system errors reported under the code System errors. Five participants found the video on YouTube blocking privacy settings hard or very hard. Two participants found the cyberstalking video very hard. See Table 23 for ease-of-use scores data with the smileometer adapted SUS scores.

Participant three had a problem with the audio, while playing the Coin game. Earphones were not working for this participant, eventhough they were checked beforehand. At the previous November 2nd 2022 session, support workers said that combining sound and video would be the best approach. This feedback was implemented. Another suggestion was that the Coin game answers should be colour coded or numbered.

Four of the five of the participants in one lab session said that the coin game was their favorite part of the application (recording at 29:45). See [Appendix O](#) for screen shots from the Coin game. All students finished the Coin game, including participant number four who came late into the lab. After finishing the five tasks, some students started to play the Maze game, which they had tried out in previous lab sessions.

6.6.3 Final Lab Session results

The same four themes were identified when participants interacted with the FINAL version of the *CyberSafe* prototype in spring 2023. These results are taken from the quotes from researcher observation comments during the lab sessions for two groups of seven and four participants respectively, from the associated lab Camtasia recordings and from the

answers of the 11 Adapted SUS questionnaires. In the final lab session in spring 2023 with 11 new participants, positive and negative usability sub themes emerged again. Seven participants reported strong positive usability scores in both the intuitive findability and navigation code observations in the Camtasia recordings. The summary of participant's responses in the Adapted SUS measuring self-reported usability demonstrates that most of the participants found the application features “easy” or “very easy” to use.

Table 24 Ease of use scores from the adapted Usability Questionnaire

Ease of Use	Very Easy	Easy	Hard	Very Hard
Catfishing	8	3		
Coin Game Play	7	4		
Snapchat Blocking Video	5	2	3	1
Friend or Fake game	7	3	1	

Three participants found watching the Snapchat video hard and one found it very hard. This Snapchat component had an interactive simulation exercise on how to block someone built into its workflow. This interactive simulation exercise presented a challenge for four of the eleven participants. More research is needed into how to redesign the interactive simulation so that these four participants can understand it better.

6.6.4 Summary of Usability theme across the 3 iterations

In the second lab iteration, the care worker suggested making videos more interactive, if possible. These findings emphasised the importance of giving users more control over the interface and content. Participant feedback from the second iteration session was incorporated into the final evaluation version of the *CyberSafe* prototype, in readiness for the final user evaluation. Based on feedback from the early interaction, the participants engaged well with this final iteration and positive usability observations were high despite an unavoidable system error. For this final round of evaluation workshops:

- Videos were broken down into steps.
- More interactivity in the videos was provided by providing branching options.

The Catfishing video was hugely popular and effective. The WhatsApp videos still need interaction. The Snapchat video and the interactive exercises were very effective and popular. Adapted System Usability Scale (SUS) self-report measures indicated participants “liking a lot” of the *CyberSafe* application, with the Coin Game and videos most frequently rated the highest, followed closely by the Maze game activity. Indications of what the participants would like to see more of revealed that games and videos and animations with people were most favoured. Familiarity with watching films and videos contributes to their visual literacy, which aided the users’ independence with viewing the interactive short film. Some minor obstacles to usability were noted during the lab observations and were addressed in subsequent iterations. A usability issue emerged at the end of the Coin game where participants were unsure how to exit. They actually had to click on the Congratulations screen to exit, but did not realise this. Consistency of navigation needed to be implemented in this case.

6.6.5 Preferred Platform theme

Across the three lab testing iterations, while some participants wanted to try the application on their phone, most preferred it to be on a bigger screen such as a laptop and computer. When asked if they would prefer the application on the computer, or on a phone or a tablet, participants preferred it on the computer. One participant said that they would get a headache if it was on a phone. The participants chose the laptop or iPad as their chosen preferred platform for using the *CyberSafe* application. This correlates with Rus, Caliz, Braun, Engler and Schulze (2017) study where participants preferred a tablet to a smartphone as icons and buttons on a phone were too small, which in turn feeds into affordance capability theory.

6.7 Meta-theme 6 – Support worker mediation and opinions bridging the communication barriers between PwID and researchers.

The support workers participating in the co-design workshop provided not only direct insights, but also supported the participants in expressing their ideas and needs. They supported the researcher to understand what the PwID wished to communicate in some of their comments. They were very conscious that PwID had a voice and that their experiences

took centre stage. To move away from some abstractions in the language, a support worker had the ability to relate abstract concepts (such as “*a place you go often*” or “*someone you trust*”) to concrete elements from the participant’s life (such as “*work*” or “*mum*”). Here is an example of how a support worker (S1) supported communication in Group1 (G1).

G1S1: “Some users need extra elaboration, using real world examples to help them comprehend (e.g., Are you nice to me (support worker) when you’re on WhatsApp)”

Here, the support worker provided the researcher with additional information, while allowing the participant to deliver the information by way of ensuring that the participant remained at the centre of the conversation. This example illustrates the language shift between abstract concepts and concrete instantiations of these concepts. Support workers/proxies were able to contextualise the responses provided by participants. For example, when a participant told us that he would give his personal information to a stranger, the support worker could clarify that this was in the context of the ICE (Identity Card in Emergency), if they got lost. Support worker opinions were also very helpful in bridging any communication difficulties between participants and I, as the researcher. For example, it was suggested by a support worker that some of the quiz question language was vague and hard to grasp, especially in the question about pretending to be someone else online. The quiz question asked: *A cyberbully can hide who they really are. True or False?*

G2S1: “I’d add to that question pretend to be someone else just because they’re not catching the point of who they really are online. It’s just the language. They’re not grasping it.”

In addition, for those lacking literacy skills, it was suggested by the support worker to colour code the yes and no buttons in the Quiz component. Furthermore, support workers recommended incorporating more audio and imagery in the application to enhance usability and accessibility for this particular cohort. Finally, support workers and proxies provided valuable insights into meaningful participant behaviour. For example, PwID participants appeared to answer instantly, without properly first considering the question, so the prompting of a support worker to “*listen to what you’re being asked*” was very helpful. Support worker mediation operated as a sociotechnical arrangement that enabled participation, illustrating how digital engagement is shaped through power relations rather than individual capacity alone. From a Social Shaping of Technology perspective, such

mediation structures how PwID access, interpret, and act within digital environments, reinforcing the relational and socially constituted nature of agency (MacKenzie & Stoljar, 2000; Williams and Edge, 1996). This form of mediated participation highlights that digital agency for PwID is distributed across human and non-human actors, including support workers, interfaces, and organisational norms, raising social justice concerns about autonomy, dependency, and the unequal distribution of control within digitally mediated participation (Latour, 2005; Light and Akama, 2014).

6.7.1 Related theme: Reassurance and Praise

In the lab sessions data, the theme of Reassurance and Praise emerged. This is related to meta-theme 6 of Carer Mediation in Figure 53.

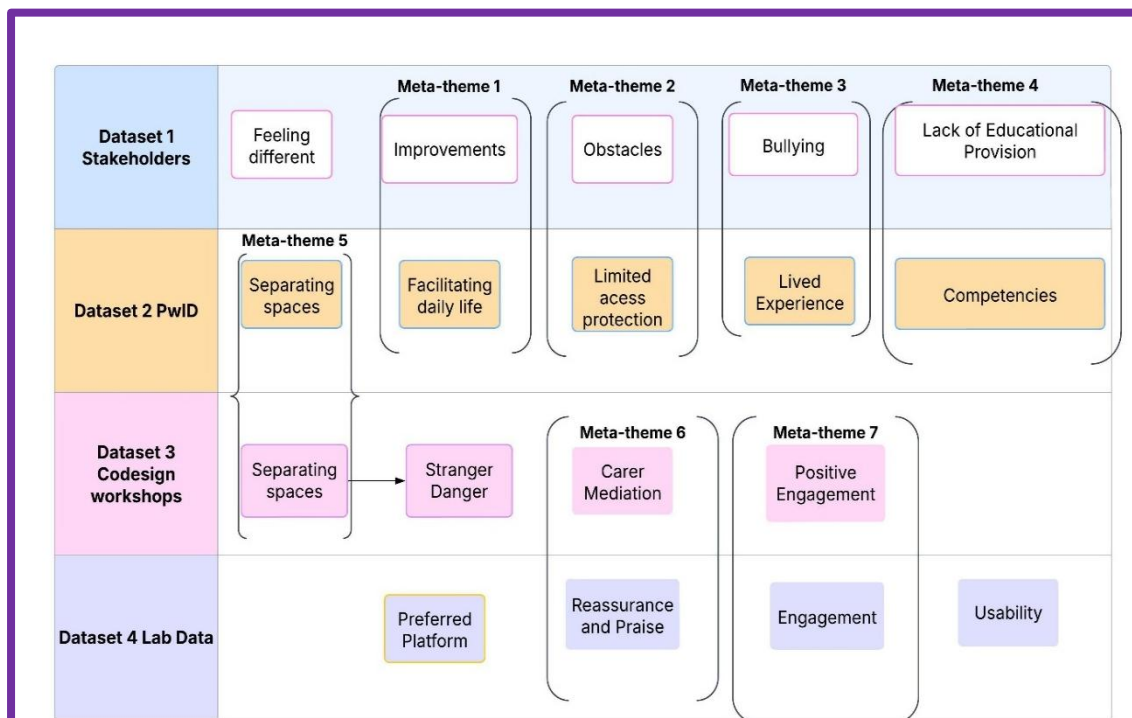


Figure 52 Meta-themes identified across the four datasets

In line with previous literature, users were initially quite hesitant using *CyberSafe* and needed reassurance moving forward in the lab sessions. During the first lab session, I observed that: “Number 1, 2, 4 and 5 needed reassurances moving forward”. However, this could be remedied, without the need for assistance, by inputting a delayed reassurance pop up in the *CyberSafe* screens for users and this is a recommendation for future iterations. See some sample data from the data coding (Table 25) under this theme below which

demonstrated that, in line with the literature, PwID greatly appreciated positive feedback when they got an answer right while interacting with a quiz component in the lab. When seeing the progress bar and encouragement when they got a question correct, I observed that “Number 2 is delighted to see the 100% progress bar.” Participant 3 in group 2 was very hesitant about clicking. While they knew the area to which they needed to navigate, indicated by the mouse hovering over the area, the participant was very slow to actually click, needing reassurance and support to continue (*PwID2*). This is backed up by an analysis of the Camtasia keystroke recordings for this participant.

Table 25 Codes related to theme of Reassurance and Praise

Theme	Sub Themes	Code	Description of Codes representing theme	Frequency	Quotes
Reassurance and Praise	<i>Help</i>	Clarification	Clarification needed	9	Group 1 <i>P3: asked for help</i>
		Focus Attention	Attention is refocused	2	Group 2 <i>P1: My mom is called Mary.</i>
		Elaboration	Further explaining needed	1	Group 1 <i>R: They can pretend to be someone else online, as they can take a picture of Johnny Sexton or Zach Ephron and pretend to be them.</i>
		Reading and Writing	Literacy difficulty	4	Group 1 <i>P4: needed help to write her answers</i> Group 2 <i>P2: Needed help reading</i>
	<i>Reassurance</i>	Hesitant	Participant hesitates	3	Group 2 <i>P6: Unsure where to click next</i>
		Reassurance	Participant needs reassurance	10	Group 1 <i>P2: needing reassurance</i> Group 2 <i>P6: Unsure where to click next</i>

6.8 Meta-theme 7—Engagement

The meta-theme of *Engagement* was initially identified in the first co-design workshop in May 2022. Recorded data was analysed to identify positive and negative emotional engagement codes for participants while involved in the first co-design workshop. Interestingly, as evidence of the positive engagement of participants with the co-design workshops, there were no incidences reported of negative engagement or frustration in the first co-design code table. One of the possible reasons for this is that the activities were appropriately designed for the participants, following much thought and consideration. In the subsequent lab activities conducted in June 2022, positive emotional responses were more frequently observed than negative ones, according to observations used to identify occurrences of positive and negative emotional engagement while using the *CyberSafe* application. The codes relating to engagement captured emotional enjoyment observed during the participant's interaction with the first prototype iteration (see Table 26). These emotional responses enhanced the overall user experience. Each group, of six participants, in each of the first round of lab sessions in spring 2022, were noticeably engaged, when they started to interact with the prototype screens on the computers in the lab. The evidence for this was an increase in their visual attention to the task, their rate of keystrokes in the Camtasia recordings as well as an increase in their concentration. Their Camtasia recordings showed no significant pauses. The participants were able to comment on or react to features of the prototype demo and indicated clear preferences on paper after the lab session activity. All of the participants were interested during the prototype testing. The components that they found to be the most captivating were the videos and games. None of the individuals showed signs of disengagement during the tasks e.g. wandering eyes or bored-looking expressions on their faces. Reading activities were challenging for or impossible for one participant who had weak literacy skills.

Table 26 Codes related to theme of engagement

Theme	Sub Themes	Code	Description Codes representing theme	Quotes
Engagement	<i>Negative</i>	Frustration	Annoyed	RO Group 1 P5: was frustrated at the slow loading screen

	Positive	Fun	Positive enjoyment	RO Group 1 <i>P5: found prototype easy and fun.</i> RO Group 2 <i>P3: really enjoyed it</i>
		Preferences	Preferences expressed	RO Group 1 <i>P2: preferred the fish</i> CR Group 2 <i>P3: Clicks favourite app rather than glowing option</i>

Participants liked the first *CyberSafe* prototype a lot, according to adapted System Usability Scale (SUS) self-report measures, with the videos being most frequently rated the highest, followed closely by the Quiz and Maze game. Indications of what participants would like to see more of revealed games and videos with people. The highest rated element of the application were videos (n =4), followed by a tie between the Maze game and quiz (n=2).

In the second iteration lab session in November 2022 with 9 of the original 12 participants attending, the participants reported that they enjoyed using *CyberSafe*. Researcher observations and self-reported usability group data as illustrated in Table 27 below support their viewpoint. All participants showed interest in the prototype, particularly in the Coin Game and Cyberstalking Quiz components.

Table 27 Like /Dislike scores from the Adapted System Usability Scale

Like	Like a lot	Like a little	Dislike a little	Dislike a lot
Coin Game	8		1	
Cyberstalking video	4	3	1	1
YouTube Blocking video	3	5		1
Look of app	6	2		1
Cyberstalking Quiz	7	1	1	
Colours	5	3		1
Pictures	7	1		1

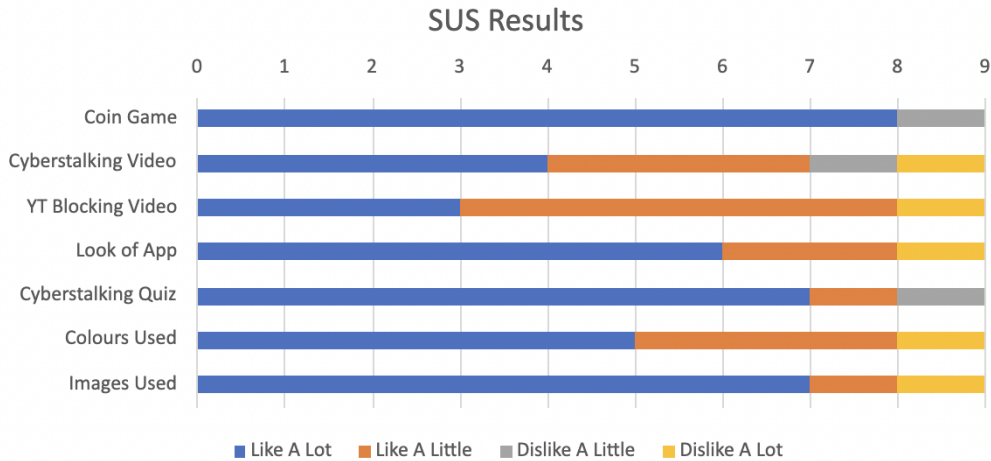


Figure 53 Adapted System Usability Score results

Coin Game task

As displayed in Figure 54, eight out of the nine participants liked the Coin game “a lot”. Students all enjoyed the Coin Game task. From the recording, they demonstrated positive engagement and verbalisations, wanting to play the game again. The researcher distributed five physical chocolate coins as a reward when students won the game. This created a lot of fun and bridged the divide between the cyber and real physical chocolate coin rewards.

R= Researcher

R: Did you find the quiz hard?

PwID1: It was alright

R: 5 coins for you. Congratulations!

Participants: Wooooo

R: Now you can play it again. Play again

G1S1 singing: Money, money, money must be funny in a rich man’s world

R: Ok Try again, Try it. Ok Try again, Try it again number 5.

R: Maybe reject ... You won 5 euros. Well done. Congratulations.

Clapping

R: If you want to take a photograph of the 5 coins, even if you show the front of the screen.

G1S3: Good Job

G1S2: *You have done all the tasks. You have every single task.*

G1S1: *Well done Name of Participant 4. Five coins for Name of Participant 4.*

Participants are playing it again here.

G1S2: *We have another winner here.*

But he (no 5) won it already. He put the coins away.

Big laugh from everyone

PwID5: *I won again.*

Cyberstalking Quiz Task

At 10 minutes, 34 seconds on recording of the lab session with Group 1, there is an example of positive verbalisation. The participants really enjoyed winning badges as they completed a quiz component in *CyberSafe*. This result is backed up by feedback in the first codesign workshop, where it became clear how much the participants liked to win badges as a form of re-enforcement and gamification. As a results of this feedback, badges were included in the next iteration of the design to add to learners' enjoyment and motivation.

R: *We have won 3 badges*

G1C2: *We got 3 badges as well*

Joyful verbalisation having won 3 badges after completing quiz..." Hu hooooo"

Participants indicated their enjoyment through cheering and clapping during tasks. In line with the research, users thoroughly enjoyed the inclusion aspect of coming to attend the workshops in my institution, IADT, which is a third level college. As going to college is a common milestone, they would see their siblings and family members doing the same. One of the support staff commented after the group 1 session that the participants really enjoyed the session, as evidence by the code *Exploration* appearing in the data, where many participants were voluntarily engaging with *CyberSafe's* features, beyond the required tasks listed for the lab session on the task sheet provided. This further illustrated the theme of engagement.

The final 11 participants in spring 2023 reported that they enjoyed using *CyberSafe*. Researcher observations and SUS group data in Table 28 supports their viewpoint. All

participants showed interest in the prototype, particularly in the Snapchat blocking video and the catfishing video. Seven out of the 11 participants like the Coin game “a lot”. The participants really enjoyed the session, as evidence by the code *Exploration*, appearing in the data, where there were 23 incidences of participants voluntarily exploring *CyberSafe*’s features beyond requirement tasks.

Table 28 Like scores from the final lab session’s adapted Usability Questionnaire

Like	Like a Lot	Like a Little	Dislike a Little	Dislike a Lot
Coin Game	7	3	1	
Snapchat Blocking Video	10	1		
Catfishing Video	7	4		
CyberSafe appearance	8	2	1	
Try it on your own Snapchat game	8	3		
Colours in CyberSafe	10	1		
Pictures in CyberSafe	9	2		

High levels of engagement observed during co-design and lab sessions indicate the importance of participatory and inclusive design approaches in supporting meaningful involvement of PwID, aligning with social justice principles of participation and voice (Fraser, 2009; Robertson and Simonsen, 2013). These findings suggest that when technologies are shaped with users rather than for them, they can counteract exclusionary design practices and foster more equitable forms of digital participation (Light, 2011).

6.9 Summary of Results

This chapter presented the results that emanated from the 3 stages of user-centred design, involving four distinct datasets. Initial data was collected with four expert interviewees who worked with PwID. There were three subsequent data collection points with young adults with ID. The four datasets to collate and analyse included:

- Stakeholder data
- PwID empathy workshops data
- Codesign workshop data with PwID

- Lab sessions data using the *CyberSafe* prototype.

The main results and observations were described in the form of meta-themes and other noteworthy themes. The most prevalent theme generated from the empathy workshops with PwID was '*Internet enabled Improvements*' i.e., how internet and mobile app usage can facilitate and improve their daily lives. This represent a meta-theme, which was both echoed in the four expert stakeholder interviews and survey data with 14 support workers and in dataset 2 from the empathy workshops with PwID. The metathemes of '*Obstacles*', '*Identity bullying*' and '*Separating Space's*' were constructed from themes emerging from the early datasets. The '*Separating Space's*' metatheme highlighted PwID vulnerability to celebrity catfishing and how risk exposure can result in positive personal growth. The theme of '*Feeling different*' was generated in the expert interview dataset, using repeated references to the lack of equality and representation online for PwID. Two key metathemes were constructed from the analysis of dataset 3 and dataset 4. These were '*Engagement*' and '*Support worker mediation*' bridging the communication barriers between PwID and researcher, which emerged from the analysis of the co-design workshop data. A noteworthy stand alone '*Usability*' theme detailed positive and negative usability aspects of engaging with the *CyberSafe* prototype. Learnability and findability scores were high which allowed the participants to intuitively learn how to use *CyberSafe*. In spite of some limited navigation issues, participants were able to identify each module and navigate to discover and interact with the relevant resources. In the lab activities, engagement levels were observed through positive emotional responses, which were more frequently observed than negative ones, while using the *CyberSafe* application. The Coin game and videos were most frequently rated the highest, followed closely by the Maze game activity. Indications of what the participants would like to see more of revealed that games and videos and animations with people were most favoured. These metathemes will be discussed in detail in relation to the RQs in the next chapter together with other insights gleaned from the co-design workshops.

7. DISCUSSION

Introduction

This study aimed to explore the key issues and challenges around cybersafety for PwID and their stakeholders (experts, policy makers and support workers). It explored the lived experiences of PwID with cyberbullying. Vulnerability, though apparent, did not strongly emerge as a theme in the first two datasets. Instead, *CyberSafe's* findings support the idea that PwID are experiencing an improved quality of life through online participation. PwID have some awareness of online risk but their cybersafety knowledge and digital literacy skills need to be improved in order for them to benefit further. This aligns with findings from the work of Alfredsson Ågren, Kjellberg and Hemmingsson (2020) when investigating younger PwID technology use. *CyberSafe's* participants described protecting themselves and avoiding some online dangers, but also lacked competences and wanted to learn and acquire new knowledge and skills (e.g., how to block people) to enable them to independently keep themselves safe online. This data informed the co-design workshops, which in turn informed the user-centred design process of the *CyberSafe* educational application. Findings from each stage of the research process were derived from the four relevant datasets. This discussion chapter will explore the findings that arose in the context of four original research questions and then address research question five with UCD guidelines in the form of a toolkit for the greater educational community, when designing for PwID. The meta-themes and themes from each of the four datasets did map onto the original research questions. Contextualisation of findings, potential study limitations and future study suggestions are incorporated at appropriate stages of this chapter.

7.1 Research Question 1

- *What are the issues and challenges for stakeholders around cybersafety for this group?*

As part of the User-centred Design process, the first dataset from stakeholders, analysed as part of this research study, generated five themes from the data, shown in Figure 55.

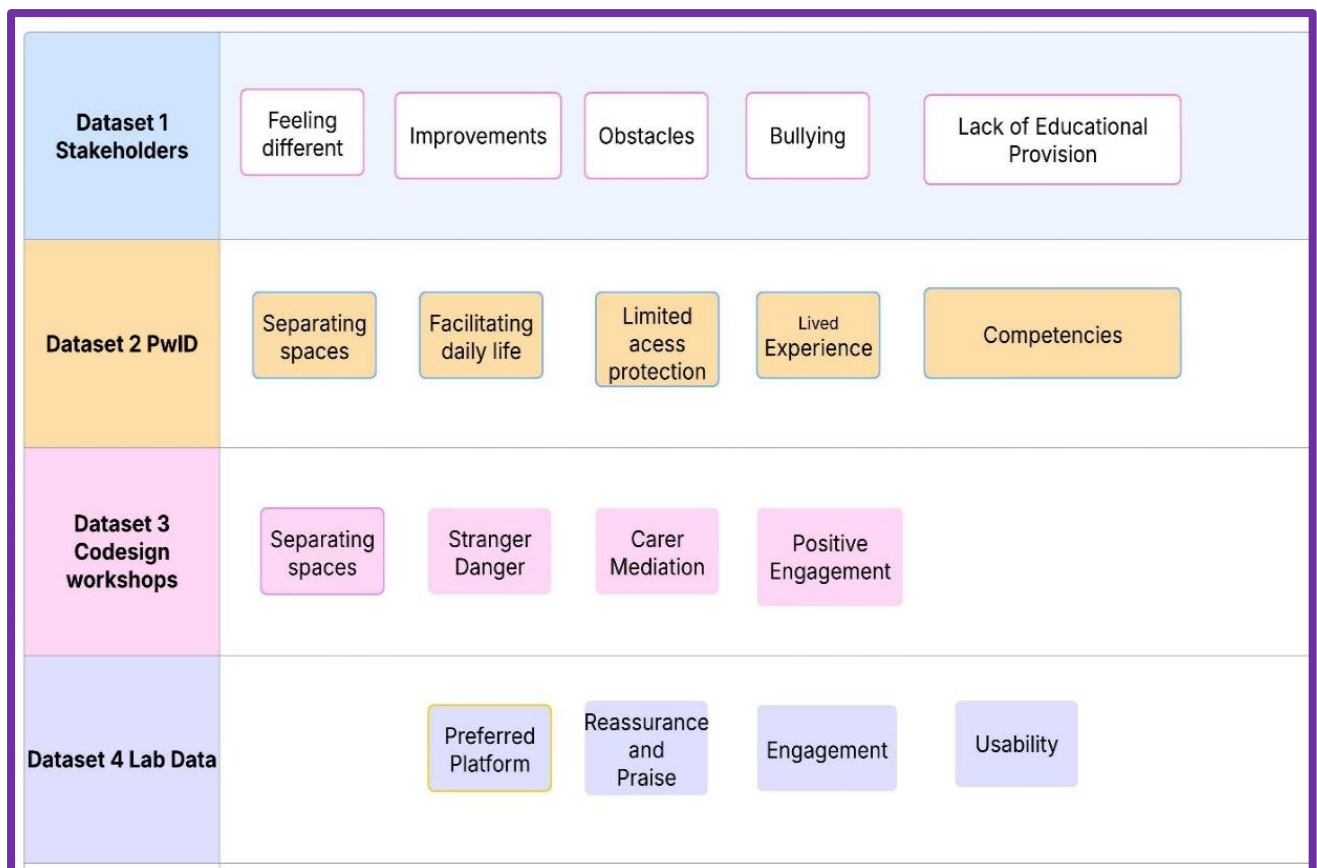


Figure 54 Themes generated across the four datasets

These themes are:

- Feeling different
- Internet enabled improvements
- Obstacles to internet use
- Identity bullying (bullied because of who they are)
- Gaps in Educational Provision.

Theme 1, "Feeling different", described a lack of equality and representation experienced by PwID online, and the experience of being treated differently. This combined with obstacles (Theme 3), such as access to the internet and parental fear can block PwID from receiving the numerous benefits of being online such as improving oneself, easier and improved connection, and autonomy (Theme 2). Theme 5 concludes with identifying gaps in provision, to develop appropriate and accessible educational resources to address the challenges of cyberbullying (Theme 4) and cybersafety.

As supported by research from the European Association of Service Providers for Persons with Disabilities (2020), expert stakeholder respondents described the impact of the COVID pandemic on how essential online access has become for PwID. In addition, the importance and necessity of PwID being online was echoed across the stakeholder dataset. Borgström, Daneback and Molin (2019) further support these findings, reporting a difference in lived experience due to the digital lag between PwID and neurotypicals. PwID, who do not understand the rules of social media, are most vulnerable to predators. Stakeholder respondents indicated this lack of understanding around interacting online (i.e., netiquette) as a main concern. This lack of comprehension of codes and conventions is one of the challenges associated with the digital lag for individuals with intellectual disabilities (Lussier-Desrochers, 2017; Caton and Chapman, 2016). This aligns with recent research that some people with ID do not understand online etiquette or social norms and this can be due to their condition or simply a lack of education (Safari et al., 2024).

All four experts and 14 support workers surveyed highlighted not only the lack of current educational resources but the issue of resources not being digitally accessible to those with ID. This aligns with the statement that “one of the most cited factors contributing to the technology participation gap between larger society and PwID relates to inaccessibility due to design” (Bayor *et al*, 2021, p6.6). This is a recurrent issue in the research, which needs to be addressed. This can be viewed as an example of difficulties to act out the rights of the PwID to become participatory citizens in this digital age (Alper and Goggin, 2017). The European guidelines for website accessibility, Web Content Accessibility Guidelines (WCAG) should be addressed (European Union, 2016), in which the importance of cognitive accessibility has been highlighted. *CyberSafe’s* findings illuminate that it is vital in a digitalised society to conduct accessibility audits of websites and digital services using cognitive accessibility criteria to ensure that these services are accessible to everyone in the population, recognising that accessibility includes PwID, not just physical and social accessibility.

The second theme of *Obstacles* (also part of a meta-theme across the first two datasets) can be summarised as all the barriers PwID face to access a safer internet. A subtheme identified under the meta-theme of *Obstacles* is *tension*. On one hand, parents and guardians can be overly protective, seeing their offspring as an “everlasting child”, or

'eternal children' (Johnson *et al.*, 2010), thus limiting what PwID can access. On the other hand, parents or support workers can be under protective, not taking internet use or cyberbullying seriously. This *Obstacles* theme explores how there is either too much or too little parental control or fear of using the internet. Interestingly, data shows parental control, as either being overly or under protective, is supported by the literature (Seale, 2014; Chiner *et al.*, 2017). Furthermore, Molin *et al.* (2015) reported that PwID are dependent on the attitudes of parents and professionals regarding internet usage. This aligns with Björnsdóttir *et al.* (2024) study in Iceland which found that lack of access to technology was often linked or as a direct result of parental or caregiver enforced barriers. Disability rights and social justice perspectives highlight those relationships, where rights are either enabled or constrained, as protective practices motivated by care, can unintentionally limit autonomy and digital agency (Charlton, 1998; United Nations, 2006).

The area of online rights being overlooked was identified and is supported by Alper and Goggin (2017). Parental awareness of risks experienced by their family members with intellectual disabilities can prompt digital restrictions; similar to findings from research investigating younger PwID (Molin, Sorbring and Löfgren-Mårtenson, 2015). *CyberSafe's* findings demonstrate that both older adults and young adults with ID experience similar online restrictions. A further factor, identified in the dataset, influencing digital restrictions imposed by parents and guardians concerned financial challenges, which was also reported as a concern in literature (Chadwick *et al.*, 2016). Such restrictions can be interpreted as impediments to the development, confidence and freedom online for PwID.

Though fear of risks was evident as a contributory factor in self-imposed as well as parental and support worker mediated digital exclusion, it is salient not to overlook the risks to wellbeing of being digitally excluded for PwID for whom societal expectations are rising. This is particularly important post the COVID-19 pandemic, where many governments and educational services, supports, social networks and leisure and work activities are conducted online or in a hybrid mode (WHO, 2020; Zaagsma *et al.*, 2020). *CyberSafe's* survey findings from 14 key support workers indicated how significantly the internet impacts the lives of the people with whom they work. Overall, the themes generated from stakeholder data highlight the need to address the digital divide and promote digital literacy, which includes cybersafety for PwID. Prior to COVID, research found that PwID

were not using the internet as much compared to neurotypicals (Borgström, Daneback and Molin, 2019). However, COVID rapidly accelerated PwID internet use (EASSPPD, 2020; Zaagsma *et al.*, 2020). This raises concerns as PwID are more frequent targets of online bullying, as reflected in Theme 4 *Identity bullying (bullied because of who they are)*. It is argued that increased use will also dramatically increase online bullying cases (Iglesias *et al.*, 2019). Theme 4 Identity bullying highlighted that people with ID experience bullying and cyberbullying. A lack of education for both PwID and carers was identified in the literature (Pearson *et al.*, 2019). To address the digital divide, the findings of this *CyberSafe* study and previous literature stress the need for more targeted and digitally accessible educational resources for PwID and highlight the need for further research.

The findings of theme five “*Gaps in Educational Provision*” strongly emphasise how to increase digital accessibility for PwID. Stakeholder data highlighted that there are alternative ways for PwID to learn, which are not limited by their cognitive disability. Expert stakeholders advised using games and a clear byte sized step-by-step instructional process containing multiple modalities (video, audio, graphics and limited text). *CyberSafe’s* stakeholder respondents indicated that the most sought-after educational resource to cope with cyberbullying were videos. This finding was backed up by research by Kagohara *et al.* (2013), that instructional videos support the education of individuals with ID and by Bayor *et al.* (2021) who found video very effective with PwID. In the lab sessions, it was discovered that participants responded best to step-by-step short videos. This may be due to students being able to control their own cognitive load by being able to pause or rewind videos. The student’s ability to learn at their own pace could be the reason why video is an effective format for learning (Noetel *et al.*, 2021; Bouck *et al.*, 2014) and can be understood through the lens of affordance theory (Gibson, 1979). According to Bellini and Akullian’s (2007) review, children with autism respond well to peers or adults who serve as the video model and can learn a variety of skills, including imitation, self- help skills, communication skills, play skills, and social skills. In this *CyberSafe* study, introducing an interactive video and interactive component in the final iteration was a very successful intervention. Support workers in the two final lab sessions indicated that the interactive video was highly effective at engaging the participants, acting like role-playing tools. This aligns with research by Barman and Jena (2023) for children with ID aged 12-15 years, who performed more

actively as compared to the comparison group due to the involvement of interactive video-based instruction.

The Catfishing video involved researching and designing an interactive non-linear video storytelling interaction for learners. The interactive video developed, as part of the *CyberSafe* application, combined kinetic and narrative-based learning. The short video addressed the target user groups' experience by reflecting their position through a protagonist character. Throughout the narrative, the character is met with a series of choices to navigate their solution through the topic issue (being catfished by a fake friend). At the heart of digital storytelling is the idea that, when choosing a key moment of insight to shape into a story, one should focus on what Tripp (1993) calls a critical incident. What matters is that the chosen moment of insight is meaningful, not trivial (Hall *et al.*, 2024). The catfishing video gives the learner choices and then informs them of the consequences of the decisions they make and thus provides meaningful insight. Based on previous research (Afify, 2020), a narrative short film aesthetic was considered more effective and engaging as an eLearning asset rather than a VR simulation, which risks alienating viewers through low accessibility of the necessary distribution devices. There is scope for the development of further interactive videos to educate PwID about cybersafety.

Digital divide and digital literacy concepts permeate through the five themes generated by stakeholders. Their views ranging from an awareness of a lack of equality, obstacles and benefits facing PwID, as well as their views on cybersafety for PwID, are expressed within the first dataset in both explicit and latent terms. This provides a more nuanced understanding of the digital divide for PwID from the stakeholders' perspective. High access to technology (explicit) does not always correlate with effective use of it (latent) if individuals lack digital literacy or the skills to use it as was the case for one person with ID who had bought very expensive equipment but did not know how to use it. The story of the individual who bought expensive equipment but could not use it illustrates how ownership does not equal competence. This supports findings from Chadwick *et al.* (2013) that access among PwID does not guarantee digital fluency or autonomy. This story reinforces the argument by Salmerón *et al.* (2020) that while some people with intellectual disabilities are digitally connected, they often lack the guidance and digital confidence necessary for meaningful interaction with online tools. PwID can have negative perceptions about

technology, as was the case for the individual who choose isolation from technology as a safety mechanism, suggesting that cybersafety concerns and perceived vulnerability can drive disengagement, not just lack of skill. Furthermore, the finding that one individual deliberately avoided technology as a protective response due to safety concerns provides a fresh contribution to the literature, highlighting how cybersafety fears, whether grounded or perceived, can lead to digital self-exclusion. While Seale *et al.* (2017) acknowledge the risks of online spaces for PwID, this story brings a human dimension, revealing that self-imposed isolation from technology may be a rational choice for individuals who feel unprepared or unsupported in navigating digital environments. These findings augment current research by emphasising the interplay of emotional safety, digital literacy, and meaningful engagement, rather than focusing on access alone. They highlight the need to design digital inclusion initiatives that incorporate not only skills training but also trust-building and emotional reassurance. Stakeholder reflections provide an applied, real-world perspective as they observe not just systemic barriers but also how PwID emotionally and cognitively experience the digital world. This can fill a gap in the academic literature that is often more technical or infrastructural in focus.

Much of the literature tends to focus on the "first-level digital divide" (i.e., whether or not people have access to devices or internet). *CyberSafe's* findings addresses the "second-level divide" (i.e., how effectively that access is used), which is less frequently explored in PwID research (Van Dijk, 2005; Chinn and Fairlie, 2019). Understanding these layers helps in formulating policies aimed at bridging the digital divide for PwID. This multifaceted approach allows researchers and policymakers to identify not just, who is lacking access, but also why that access may not translate into meaningful engagement with technology. These insights extend current literature by shifting the focus from infrastructure to human-centred digital inclusion, encompassing skill development, safety awareness, and emotional empowerment. The findings of this study have clear implications for policy and practice, particularly in relation to national digital inclusion and disability strategies. Although participants and stakeholders noted high levels of access to digital devices, several barriers to meaningful use remain. These include limited digital literacy, minimal support for learning, and concerns around cybersafety. These insights suggest a pressing need for policy shifts that emphasise support and empowerment (Bell, 2016), not just infrastructure. This

study highlights the importance of ongoing support for PwID to build digital literacy. Personal care plans could be strengthened by incorporating regular, personalised digital training sessions, delivered either by support workers or tech mentors trained in disability awareness. As one participant's story in this research showed, simply owning expensive technology is insufficient without the ability to use it safely or confidently. The concerns around cybersafety also point to a gap in outreach to people with intellectual disability. Participants expressed fear of being taken advantage of online, with some choosing to disengage altogether. This raises the need for tailored digital safety education initiatives, ideally co-designed with PwID, to build both confidence and competence online.

This *CyberSafe* study recommends that meaningful engagement with technology and the internet together with cybersafety skills should be incorporated into secondary-level education and special education classes to help improve the learning outcomes of and prepare PwIDs for the future. Further research should assess the long-term learning outcomes of these digital literacy skills (DLS) programmes to understand how they could be improved and developed. This research could then inform government policy on how to implement DLS training in all levels of the education system. This insight augments research conducted by Baxter and Reeves (2022), who argued for the inclusion of DLS training programmes in secondary-level education and recommended fundamental DLS skills that should be included in these programmes. Whether explicitly discussed or not, within the data and subsequent analysis, the digital divide and lag is clearly highlighted in stakeholders' views about cybersafety for PwID.

7.2 Research Question 2

One of the present study's goals was to describe the lived experience of PwID online and to answer research question 2: *What key issues around cybersafety do young adults with ID report?* This was achieved by identifying five major themes, listed below, in the empathy workshop dataset, conducted with PwID. This discussion employs both a deductive approach relating these themes to the literature and an inductive approach letting "the voice" of the participants with ID speak for themselves (McDonald, Kidney and Patka, 2013, p.217). As reported in the results graphic in Figure 55, the following themes capture the overall story of the PwID dataset:

- Facilitating daily life.
- Limited access and Parental Protection.
- Separating physical and cyberspace.
- Lived experience of bullying/cyberbullying.
- Competencies

7.2.1 Meta- theme: Internet enabled improvements.

The first theme of *Technology facilitating Daily life* became part of the meta-theme *Internet enabled improvements* across the dataset as it emerged also in the first dataset from stakeholders under Internet enabled improvements. This meta- theme correlates with the findings from the 14 instructors, conducted for *CyberSafe's* RQ1 previously discussed. This meta-theme can be summarised as technology enabling improved quality of life for PwID as well as improving guardian and support worker quality of life. Concerning access to smartphones, this *CyberSafe* study found that 23 of the 24 participants who took part in the workshops had their own mobile phones. Ireland has one of the highest number of mobile phone users worldwide (theGlobalEconomy.com, 2025) and *CyberSafe's* sample reflects this national phenomenon even among PwID. Alfredsson *et al.* (2020) study found that 65% of the participants with intellectual disabilities had access to smartphones. This represents a huge increase on previous studies (Livingstone and Smith, 2014), where only 20% of PwID had access to mobile phones, but similar to research from Spain (Jenaro *et al.*, 2018) with 73% of PwID having access to smartphones. This is representative of the rapid acceleration of access to Internet-enabled devices and their accessibility, even to young PwID during the years separating the various studies. A high proportion of the participants watched film clips (on YouTube) and listened to music, and this result aligns with other studies for PwID (Livingstone and Smith, 2014).

This theme of *Internet enabled improvements* is heavily supported in the literature (Gilroy, McCleery and Leader, 2017). *Internet enabled improvements* explores how the internet facilitates autonomy and decreases support worker pressure. WhatsApp was found to be the most frequently used application for communication among PwID. WhatsApp is advantageous for PwID as it facilitates multimodal communication such as voice messages

instead of solely text. It also affords the ability to send photographs and music links which can be absent in other applications. The popular use of Whatsapp, highlighted by the *CyberSafe* data, is heavily supported by the literature. Balasuriya *et al.* (2018) reported how 72% of 18 participants with ID preferred using their voice compared to texting and how voice-activated interfaces facilitate alternative communication and independence. Other researchers (Morin *et al.*, 2018) support the internet facilitating alternative and increased communication, as also highlighted by the *CyberSafe* data which identified these variables as impacting the quality of lives of PwID. This present *CyberSafe* study found that TikTok and Alexa allow participants to explore hobbies. However, they are far less utilised compared to WhatsApp and YouTube and appear to be favoured by those who are already tech savvy. Chadwick and Fullwood (2018) reported how social media can help PwID feel like everyone else by increasing their social capital, also supported by other research (Caton and Chapman, 2016). Internet access can also allow PwID to free themselves of their disability and associated stigma (Molin *et al.*, 2015). These results align with the *CyberSafe's* previous stakeholder qualitative analysis, which demonstrated that the internet facilitates autonomy, communication, and skill acquisition. This, in turn, greatly improves quality of life for PwID and support workers as it decreases the need for assistance.

7.2.2 Theme two: Limited access and Parental Protection (related to Meta-theme of Obstacles)

This theme, from the point of view of PwID themselves, can be summarised as one of the barriers, which hinder PwID to accessing the internet. It has been found that PwID are a distinct subgroup within the population with disabilities who have less access to digital devices than those without intellectual disabilities (Alfredsson Ågren, Kjellberg and Hemmingsson, 2020). One reason for this is gatekeeping due to the fear of online negative comments, messages and contact (Seale and Chadwick, 2017). One issue identified in this *CyberSafe* study was limited access via WiFi at the participants' training centre. It was not clear why this was so. The literature highlights outdated technology in training centres and family homes (Alfredsson Ågren, Kjellberg and Hemmingsson, 2020). PwID are not using the internet in their training centres as much compared to neurotypicals. The findings of this *CyberSafe* research study stress the need for better technology resources and access for

PwID and highlight the need for future research on how to strike a balance. This balance is between over-exposure to internet risks causing fear and avoidance or underexposure resulting in exclusion, a broadening of the “digital lag”, and increased vulnerability. Research into the ways in which service providers and support workers attitudes, impact engagement with, and management of, risk in PwID is clearly needed to address the digital lag and bridge the digital divide for this cohort. When combined with restrictive safeguarding practices, these practices contribute to a layered form of exclusion that operates across technical, social, and institutional domains. Winner’s (1980) assertion that artefacts can have politics is particularly salient here, as seemingly neutral technologies and policies actively shape who can participate, how, and under what conditions. Addressing gaps in PwID’s education, training and living situations and restrictions in support and internet use are also key to addressing this issue. From the digital divide perspective, it is important to not only identify who faces barriers but also why those barriers exist. For instance, even if individuals have access to devices, they may struggle with digital literacy due to insufficient training or support. Additionally, their perceptions of technology, shaped by past experiences or societal or parental attitudes, can further complicate online participation. This highlights how power operates not only through external restrictions but also through internalised narratives about risk and vulnerability. As Selwyn (2010) argues, digital exclusion is often sustained by social and cultural factors that shape individuals’ confidence, expectations and perceived legitimacy as technology users.

By focusing on both explicit access and the latent factors influencing the digital divide, all concerned stakeholders can create more effective strategies for digital inclusion for PwID. Understanding these dimensions can inform interventions designed to bridge the digital divide for PwID. *CyberSafe’s* findings recommend:

- Designing training programs that enhance digital literacy including cybersafety and confidence particularly at second level education.
- Awareness campaigns to reshape perceptions of technology and the internet as a positive tool.
- Development of accessible online resources and communities that foster social connections.

These findings reveal that digital exclusion for PwID is deeply entangled with power relations that operate through families, institutions, and safeguarding practices. Rather than resulting solely from individual impairments or lack of skills, exclusion emerged as a socially produced outcome shaped by decisions about access, control and acceptable risk. This aligns with Social Shaping of Technology theory, which emphasises that technologies are embedded within social structures that reflect and reinforce existing power dynamics (Winner, 1980; Williams and Edge, 1996).

7.2.3 Meta –theme: Separating Spaces (physical and cyberspace).

The Separating Spaces meta-theme was constructed from the data generated from both the empathy and co-design workshop. The subtheme of Dissonance illustrates how PwID have difficulty separating physical space from cyberspace. When topics like safety and privacy were mentioned, some participants thought immediately of the privacy of their own bedroom. This concurs with Shogren et al. (2006) who surmise that much of the terminology that is used in the world of the internet and cyberspace may be confusing to PwID. The severity of cognitive impairment is likely to be the key determinant of internet and app usage. Individuals with mild cognitive impairments have been reported to be more frequent Internet and app users (Normand and Sallafranque-St-Louis, 2016). Those individuals, who do not operate at an abstract or symbolic level of communication and understanding are less likely to be able to engage meaningfully with cyberspace even with support. The participants of the *CyberSafe* empathy workshop had a mixture of mild to moderate cognitive impairments.

The subtheme called *The Efron Effect* described the vulnerability of PwID to catfishing, which is the practice of pretending on social media to be someone different, in order to trick or attract another person. This subtheme resonates with the research from the co-design workshops where the theme *Stranger Danger* was generated. *CyberSafe's* results demonstrates that PwID have difficulties discerning who is real and who is not real online and are vulnerable to catfishing. Unfortunately, although there are many academic articles about catfishing, Celebrity Catfishing appears under researched and even more so when it comes to this phenomenon with PwID. Users create a fake account impersonating a celebrity in many ways. They use their images for profile pictures and

online posts, and they mimic their way of writing and acting online (Paat and Markham, 2021). *CyberSafe's* findings have shown that the mild to moderate intellectual user group are vulnerable to this kind of celebrity catfishing, which comes under the sub theme of The Efron effect. There are few studies focussing on how online harms affected PwID and those providing them with support during and since the COVID-19 pandemic. Instead, security concerns were only identified as a barrier to digital inclusion (Power *et al.*, 2021; Rawling *et al.*, 2021). This is a considerable oversight considering the increasing sophistication and prevalence of cybercrime. Septanto *et al.* (2024) found that digital literacy is an important tool in the mitigation of online cybercrime as individuals can better understand the risks and allow for increased critical thinking when using the internet. Therefore, there remains work to be done in researching how online frauds affect PwID and educating vulnerable adults about these potential frauds.

7.2.4 Theme four: Lived experience of bullying and cyberbullying related to Meta-theme 3 Identity Bullying.

The lived experiences of cyberbullying and other online contact risks have seldom been studied for PwID. There is a dearth of research on this topic from the perspective of PwID, as they are a group of people who are often overlooked. They are viewed as more challenging for researchers due to their cognitive and communicative challenges. Research by Chadwick (2022) addressed this topic for persons with mild ID. To address the gap for persons with moderate ID, this *CyberSafe* study applied qualitative approaches to consider the phenomenon of online contact for PwID. *CyberSafe* participants were asked, firstly, about their experience of face-to-face bullying, to ascertain their understanding of the concept of bullying itself and to assess their coping skills, if any. It was interesting to see how capable participants were in responding to physical bullying in the real world. Respondents were informed on what to do if they saw bullying take place in the real world, to “just ignore them, just walk away”. The *CyberSafe* data illustrates how PwID are victims of online cyberbullying, mainly through mean or nasty comments. The majority of participants described experiences of cyberbullying; both which they had seen and experienced personally. A number of participants in this *CyberSafe* research study had personally experienced cyberbullying while others had seen instances of cyberbullying. They described

their experiences of cyberbullying through receiving hurtful messages online. Borgström, Daneback and Molin (2019) further support these findings, reporting that PwID are at a greater risk for bullying, cruel actions, and threats when compared to neurotypicals. It was also heartening to see that some participants were informed on what to do if they encountered bullies in the online space, sharing their experience on what they did to resolve the issue. Participants reported being frightened by bullies on games platforms and were not sure how to report bullies when playing video games. While it is not clear from this interaction if the participants play online or offline, online gaming is an area, which is not currently covered in *CyberSafe* but is notorious for violent verbal abuse and harassment (Milosevic, Laffan and O'Higgins Norman, 2020). Some participants in the *CyberSafe* study appeared to have knowledge and awareness around different online risks. For nearly half of the participants, this was based on their own personal experiences of cybervictimisation, including cyberbullying in the form of receiving negative online comments and messages. Participants expressed having experienced negative consequences resulting from victimisation. Specifically, participants in this *CyberSafe* study reported some form of psychological implications following their experiences of cyberbullying. Recounting their experience of bullying and cyberbullying affected the emotional well-being of the participants in the Empathy workshops. Psychological consideration of the emotional responses to online negative experiences has seldom been considered for PwID. Emotional responses to contact risk involved *CyberSafe's* participants using language, representing surprise (e.g. when asked about being contacted online by 'Zac Efron' or 'Johnny Sexton'). In relation to online content and conduct, *CyberSafe's* participants expressed discomfort and fear (i.e., upset, anger, worry) when experiencing aggressive or nasty comments. Although the bullying described by some participants happened some time ago, it was still affecting them years later. While all the participants, who had direct online risk experiences reported negative emotions following the event, in some cases, they also experienced growth, similar to what is termed post-traumatic growth (Tedeschi *et al.*, 2018). Participants communicated strong advice, which they would give a friend who was experiencing bullying or cyberbullying. Some individuals suggested seeking support from others including parents, key workers and friends. A number of participants recommended ignoring the bullies. This advice demonstrated improved confidence and learning from the bullying experience, which

later allowed them to use their experiences to support others. This is a new finding, as while PwID experience post-traumatic growth, as well as resilience and recovery (Scheffers *et al.*, 2020), there are limited studies examining growth in confidence in the context of online bullying for young adults with moderate ID. It has been reported by Chadwick (2022) that young adults with mild ID developed resilience following online risk. These findings allow for greater awareness and understanding of online risks, which can contribute to a positive risk-taking approach (Seale and Chadwick, 2017). This finding has implications for the digital divide in terms of challenging barriers to digital inclusion, because of too much focus on protection from harm for PwID. This finding demonstrates how risk exposure can result in positive personal growth. PwID must be given the dignity of being exposed to risk like everybody else (Perske, 1972). Positive risk-taking approach is defined by shared decision-making, creativity and resilience (Seale, 2014; Seale and Chadwick, 2017; Seale *et al.*, 2013). However, it is important to explore such risks to ensure all concerned stakeholders can undertake effective decision-making and reduce the digital lag. Because participants in this *CyberSafe* study had difficulty separating their lived experience of bullying from the concept of bullying itself, without being triggered and getting upset, skill development, resilience and post-traumatic growth literature, need to be developed for PwID. This should consider both the negative and positive consequences of online risk experiences (Cooper and McLeod, 2012). There needs to be interventions aimed at building and fostering post-traumatic growth in those who have had negative online experiences, as part of building resilience and promoting continued digital inclusion in a post-pandemic world. Future research into the psychological, emotional and lifestyle impacts and repercussions of online risks along with coping strategies used by PwID is necessary. Taking a risk-averse approach may not serve the best interests of PwID in closing the digital divide.

CyberSafe's results highlight again the lack of education for both PwID, guardians and support workers on the effects of cyberbullying, as was identified in the literature (Pearson *et al.*, 2019). PwID have online contact risk experiences in the form of image-based sexual abuse through receiving unwanted sexual messages and requests to send sexual images of themselves on the Internet (Holmes and O'Loughlin, 2012). Surprisingly, the *CyberSafe* findings observed no data on inappropriate image sharing/sexting, even though the question was asked whether anyone had received inappropriate images, in both

rounds of empathy workshops. This is in contrast to Holmes and O’Loughlin (2012) findings. The participants’ gatekeeper asked me explicitly to cover Coco’s Law (2021) in the empathy workshops, educating on the criminal consequences of sending unwanted sexual images. The reason for a no response in the empathy workshops to the question whether anyone had received inappropriate images may be due to embarrassment or some other reason. Additionally, participants may have been reluctant to revisit any upsetting feelings associated with these experiences. They may have forgotten them, as a coping mechanism, or may not have wished to talk about them in a group setting. It is also possible that, due to recruitment being managed by the gatekeeper of the services involved, that individuals engaged in this behaviour, may not have been encouraged to participate in the research.

7.2.5 Theme of Competencies, related to Meta-theme of Gaps in Provision.

This theme highlights the need to increase the competencies of PwID to bridge the digital divide and in particular to make their use of mobile apps safer. Participants all had some awareness of online risks such as the participant who said *“I blocked them from my WhatsApp and deleted their phone number”* but there were still areas of self-confessed difficulty where people needed more support such as the participant who said *“I don’t know how to remove, block or report someone”*. The data from the PwID empathy workshops revealed evidence of areas where particular risks were not well understood e.g. catfishing. The need for education around internet risks and cybersafety for PwID has been stressed by other researchers (Borgström, Daneback and Molin 2019; Houchins *et al.*, 2016; Alfredsson Ågren, Kjellberg and Hemmingsson, 2020; Chadwick, 2022). Some of *CyberSafe’s* findings supports assertions made by Seale and Chadwick (2017) that some PwID will be able to manage online risks themselves and that a better balance between autonomy versus safeguards should be enacted with PwID, who surf the internet and social media.

CyberSafe’s data highlights in particular educational gaps in the following two areas:

- Privacy online was a concern for some participants. When I asked about privacy settings, some participants did not know how to block people, which highlights the need for more education around this topic. This concurs with previous research that PwID are vulnerable when using social media, particularly due to their inability to use the privacy settings (Daems *et al*, 2015). Qualitative research

by Chalghoumi *et al.* (2019) highlights privacy breaches as a risk for people with intellectual and developmental disabilities. These findings resonate with the lived experiences of the *CyberSafe* participants, where concerns regarding privacy for one participant was a factor underpinning his self-imposed digital exclusion.

- More education is needed for PwID on Real versus Fake friend requests e.g. *The “Efron effect”*. This will help to protect PwID from predators, who were identified by stakeholders as being their main threat to their safety in the online world.

7.3 Research Question 3

This section discusses the main observations with respect to research question 3; *What aspects of a participatory co-design workshop work for this user group?* The challenges and benefits of including PwID in participatory research (Aswad *et al.*, 2022) is now finally being documented more in the literature. Involving PwID as co-designers of assistive information technology (IT) applications is increasingly being explored (Bayer *et al.*, 2021). Overall insights from this *CyberSafe* research study about what aspects of a participatory co-design workshop work best for PwID are summarised in two metathemes that appeared across the datasets.

- Meta-theme of Engagement
- Meta -theme of support workers mediating information

Other insights gleaned from the co-design workshops are described as follows:

- Genuine involvement of young people with ID in co-design
- Participation in conceptual thinking and creativity
- Handling response bias
- Overly complex concepts
- Method story approach

7.3.1 Meta-theme of Engagement

This *CyberSafe* study confirms that co-design sessions should be engaging and enjoyable to be productive (Penny, 2022). The first group of 12 participants were noticeably more engaged when they started to interact with the prototype screens on the paper exercise sheets in the co-design workshop than in the empathy workshop session. The evidence for this was an increase in their visual attention to the task, as well as an increase in their verbal responses. Their facial expressions revealed that they were excited especially when interacting with the paper based tactile exercises. The participants were able to comment on or to react to features of the prototype demo and indicate clear preferences on paper during co-design workshop one. Participants expressed preference for a Harry Styles look alike character (singer pop star), similar in appearance to the Johnny Sexton character (former and very famous Irish rugby player). It is interesting to note that PwID share neurotypical young peoples' obsession with the trend setter singer Harry Styles. This provides a clear example of a mass parasocial relationship (Garcia, Björk and Kazemitabar, 2022). This happens when people exert energy and interest in a relationship with a public figure, like a popstar, who is largely unaware of their existence. Often mediated through social media, this parasocial relationship fosters highly idealised, versions of public figures. *CyberSafe's* findings illuminate how PwID are vulnerable to this kind of celebrity worship and are thus very vulnerable to catfishing. It is heartening to report that all of the exercises in co-design workshop one, which was informed by previous research, worked well in a participatory context for this user group. The benefits from the *CyberSafe* codesign workshops appeared to align with similar benefits noted by Turner, Merle and Gotteland (2020) for co-designers, particularly in terms of "enjoyment", "sense of inclusion" and "ease of use". As one participant remarked, "This is good fun". In this way, the lab interaction session not only enhanced current knowledge of cybersafety but also allowed the participants to experience inclusion and college access in a way they would never have experienced before. My observations concerning engagement with *CyberSafe's* early stage screenshots in the six exercises undertaken in co-design workshop one are consistent with previous research on participatory and co-design toolkits (Sanders *et al.*, 2010 ; Bayor *et al.*, 2021; Sitborn and Farhin, 2017). The participants enjoyed being involved in the workshops, which for them was a very positive experience.

The PwID participants casually discussed the benefits of co-design participation throughout the process. Some participants said that through participating in the activities, they were able to be more creative and learn. One participant commented that he wanted to come and do a course at my college (IADT). Some participants shared that since taking part in the sessions, they were more conscious of online safety. They enjoyed being part of a college experience and found the co-design sessions fun. This finding supports earlier studies involving children (Benton and Johnson, 2015) and young people with ID, suggesting that participation in design activities can foster feelings of enjoyment. The participants frequently described participation as a positive experience. *CyberSafe's* findings suggests that co-design activities with PwID may be an opportunity to learn. This finding concurs with Raman and French (2021) study, which demonstrated learning, ownership, increased creativity, and making friends as impacts of participation in design activities for PwID. A support worker commented that these participants rarely get the opportunity to take part in such a creative exercise outside of their own organisation or service provider. The importance of being included, listened to and treated with respect were emphasised as significant benefits to better understand the impact participants experienced. At the end of the final session, when I was thanking them for their participation, the participants were genuinely delighted with the One for All shopping gift voucher given to them as a token of appreciation for their contribution to the *CyberSafe* research study. The co-design sessions helped greatly improve the digital accessibility of *CyberSafe* and made a small impact on the digital divide for this group of participants. They had a positive effect on community building and they highlighted the needs of PwID. In this instance, hosting the co-design sessions in a 3rd level college environment had the added benefit of providing PwID with a glimpse and experience of mainstream education. Additionally, the participants were supported to engage with a new group of people, with whom they normally would not work, under regular service provision (Boland *et al.*, 2018). PwID are one of the most socially excluded groups (Safari *et al.*, 2024), therefore participation in co-design activities may provide an opportunity to meet new people outside their usual networks.

7.3.2 Meta -theme of support workers mediating information

The value of the support workers as proxies mediating information was evident in the two *CyberSafe* co-design workshops. Social Shaping of Technology theory emphasises that technology use is mediated by social relationships among users, caregivers, professionals, designers, and institutions, which collectively shape how digital technologies are interpreted, accessed, and regulated (MacKenzie and Wajcman, 1999; Orlikowski, 2000). The support workers, who accompanied the participants to the sessions, as part of ethical approval obtained, offered very valuable insights and facilitated meaning and enhanced understanding. They clarified the meaning of some questions, highlighted discrepancies in understanding as in the example of the ICE (identity document) card, and prompted participants to share their experience, views and preferences. The delicate balance in engaging proxies was discussed earlier in the literature. This balance was managed in the *CyberSafe* workshops as can be evidenced from the transcripts. Support workers only intervened, when a participant with ID had difficulty understanding and provided a useful and significant perspective. PwID's ability to engage safely online depended on the mediation of others, whether through assistance in interpreting abstract concepts, navigating interfaces, or contextualising online interactions. This aligns with theories of relational autonomy, which conceptualise agency as socially constituted rather than individually possessed (Mackenzie and Stoljar, 2000). From this perspective, PwID's agency is distributed across networks of relationships, technologies, and institutional arrangements. A commonly occurring issue within research is biasing individuals or influencing their answers whether knowingly or not. This can be more pronounced in more vulnerable populations like PwID (Aswad *et al*, 2022). Careful attention was given to language, prompts and turn-taking in the co-design workshops, as can be evidenced in the transcripts.

7.3.3 Genuine involvement of young people with ID in Co-design

Planning in advance emerged as crucial to understanding how to create the ideal conditions for participation in the co-design workshops. The St John of God support workers' input and insight as well as previous experience with the user group helped me to treat participants with respect and compassion. Reading and research directed the creation of techniques and tools. I was able to build trust and cultivate a cooperative connection with

the PwID participants, through meeting them previously in the empathy workshop sessions. Genuine involvement was facilitated also by getting to know them in a comfortable social atmosphere during coffee breaks. This aligns with a recent study by Safari *et al.* (2024) with PwID, who highlighted the role of informal conversations about leisure activities during activities and breaks in the development of interpersonal relationships. *CyberSafe's* results indicate that social interaction can be encouraged by participation in design activities. This is supported by earlier studies reporting that design activities can encourage positive social experiences in young people with intellectual disabilities (Raman and French, 2021). Attending to their needs was also important e.g., for vegan food for one participant, and respecting their decision to leave the session, if needed, as happened in the first empathy workshop. Participants found the sessions comfortable and approachable as one support worker made the observation during the session that everyone was bringing their unique knowledge and experience to the research. A support worker also noted that participation in the co-design process was very special for the participants, as they very much welcomed the opportunity of being recognised as experts on their own needs. A high level of participation at all levels, was observed as indicated by attendance and ongoing participant comments. All participants were motivated to attend each session, voluntarily, and the involvement established a pattern for them. This outcome could be ascribed to the way in which the sessions were planned and conducted.

Aesthetic consistency in the design of tools and artifacts, as well as the recurring use of consistent accessible materials like task sheets, happy faces and laminated components enabled me to improve visual and cognitive continuity during *CyberSafe's* development. Support staff members noted that using simple language, little text, photos, and objects like the laminated components during the sessions aided participants in communicating, understanding, appreciating, and finding meaning. This *CyberSafe* study also revealed that the multi-modal approach (e.g., paper, prototype, video clips etc.) enabled interaction and collaboration by allowing each participant to engage and share in sessions in the way that seemed most natural to them. For students with intellectual disabilities, multi-modal approaches have proven effective in supporting communication, engagement, and learning. These strategies incorporate multiple channels of input and expression, such as visual aids, physical interaction, verbal cues, and symbolic representations, to align with diverse

cognitive and sensory profiles. This aligns with research by Sitbon *et al.* (2022) who developed a multi-modal conversational system integrating text, touch, and speech, which users with intellectual disabilities reported as more accessible and empowering for collaborative tasks. These findings underscore the value of environments where students can engage using the modes that best match their strengths, thereby fostering autonomy, interaction, and deeper learning. While all of these aspects were positive, more time could have been spent on coaching the participants for co-design interactions. While the user group have an intellectual disability, they are still very capable of stating what they do and do not like.

Technological outcomes are shaped by who is able to meaningfully participate in their design and whose interpretations and interests are translated into artefacts (Bijker, Hughes and Pinch, 1987; MacKenzie and Wajcman, 1999). When codesign privileges abstract discussion and symbolic representation, it implicitly selects for participants who possess dominant cognitive and communicative competencies. As a result, people with cognitive or sensory impairments may be formally included but substantively marginalised, limiting their capacity to shape technological outcomes. They are present but lack interpretive power, meaning their needs and experiences are less likely to be inscribed into the technology itself (Winner, 1980). Rather than requiring participants to abstract future scenarios or conceptualise system architectures, tactile methods allow engagement through direct manipulation, sensory feedback, and situated choice-making. By shifting codesign from cognitive abstraction to embodied interaction, the locus of expertise moves from verbal reasoning to lived, sensory experience. This shift has significant implications when viewed through social justice theory. Codesign processes that systematically disadvantage people with cognitive or sensory impairments violate Rawl's fairness principle (1971) by structuring participation in ways that predictably exclude them. Similarly, Sen's capability approach reframes justice as the real freedom individuals have to achieve valued functionings (Sen, 1999).

7.3.4 Participation in conceptual decision-making and creativity

All throughout the co-design exercises, participants were given the freedom to express their creativity and actively participate in conceptual decision-making. PWID were

encouraged to express their own views and ideas via their interaction with the *CyberSafe* prototype and doing the activities. If participants technically have access to codesign but lack the cognitive or sensory capabilities required by the method, then participation is not genuinely just. Simplified task design using tactile and material engagement reconfigures participation by enabling sensory interaction and reducing reliance on abstraction. These methods promote fairness (Rawls, 1971) and expand real participatory capabilities, enabling substantive inclusion rather than just access alone (Sen, 1999).

Using scenarios from the prototype created in the co-design workshop encouraged both individual and group expression. This collaboration strengthened the meaning and purpose of the activities and made participation less intimidating. For instance, in the first co-design workshop, I noticed that the scenario situations, of characters travelling through the Maze, promoted conversation while the empathy workshop exercises allowed individual expression of lived experiences. The visual prototype consolidated fresh concepts and revelations from each session, making conceptual choices clear and allowing participation from all participants. Participants were given resources, including graphics and video snippets, to aid in their scenario building in the first co-design workshop. As highlighted in the Miro planning tool sticky notes, the co-designers required support and encouragement to adopt new ways of being and doing, learn from others, and have their voices heard. To support that, I realise now that I needed to act more as a facilitator and coach or at least have another facilitator present to help during the session. One incident demonstrated the need for more training and coaching of the participants. A free flow exercise highlighted the fact that some of the participants did not grasp the function of the applications' breadcrumb buttons (which highlighted the users' navigation trail) and why these buttons are usually positioned at the bottom of the screens. These intuitive features were found to facilitate ease of use and were described as 'breadcrumbs to guide navigation' and demonstrated to be suitable for users with ID (Dam *et al.*, 2023).

7.3.5 Response bias

While one of the outcomes of the *CyberSafe* co-design study was a co-designed application that would teach vulnerable adults about cybersafety, more benefits were

achieved and challenges encountered for the co-designers, support workers and I. Gibson, Dunlop and Bouamrane (2020) stated that response bias tends to be prominent within the ID population. They suggested that adults with ID are often “people pleasing” and may provide the answers they believe are expected, rather than their own views. The 12 experts involved in their study highlighted response bias occurring in interviews involving open-ended questions. The experts also suggested that it may be a relevant issue within closed questions, such as rating scales, where the participants tend to select the most extreme options. In this *CyberSafe* study, support workers did take a positive role in highlighting response bias. As they are familiar with the individual with ID and their life experience, they could recognise when the responses were inaccurate. This could be seen also in the *CyberSafe* prototype usage, as when navigating the Quiz, some participants would just click without reading or listening to the question, a behaviour also prominent in neurotypicals when doing quizzes. Often if they got it wrong, participants would instinctively click the alternative answer, rather than attempting to comprehend the question. However, once prompted by support workers, when they took a minute to understand what they were being asked, they gave correct answers. I noticed that PwID were able to advocate for themselves and most importantly, verbalise what they did not like in the design artefacts and early prototype. Their preferences were clear during the paper based six co-design exercise in the first co-design workshop.

7.3.6 Overly complex concepts

One of the barriers described by Gibson et al. (2020, p.7) was encountered in the sense that “overly complex concepts” is an evident challenge to PwID within co-design. In my capacity as researcher/designer, I was challenged to communicate simply, clearly and in concrete non-abstract contexts, removing technical terminology. It is essential that tools are developed to reduce these challenges, for example by providing simpler explanations to break down difficult concepts. The support workers in the first *CyberSafe* co-design workshop, in reference to how one of the questions was asked, reported this particular barrier. As one support worker clarified: *“I’d add to that question “pretend to be someone else”, just because they’re not catching the point of who they really are online. It’s just the language. They’re not grasping it.”* This finding also highlights the need to be person-centred when thinking about how to best inform and work with PwID toward improving

their digital literacy around cybersafety. The importance of incorporating principles of respect and experiential learning, connected to PwID lived experience and using language familiar to them, are recommended based on the findings in *CyberSafe*. This finding is supported by Chadwick (2022), who recommended the importance of utilising language specific to PwID, when discussing and supporting people regarding online risks.

7.3.7 Method story approach

The broader *CyberSafe* design study could have benefited more from the contextual sensitivity that focuses on building the right conditions as outlined in Chapter 4 Methodology. These right conditions involved switching my focus to "what designers actually do and feel when making their methods work" (Lee, 2014, p.1) rather than on the data, the interviews, or the observation notes. Through the second co-design process, I developed a sensitivity to the participants and their context. This finding aligns with recent research by Safari, Wass, and Thygesen (2024) who found that earlier research on the design of instructional interfaces with PwID has primarily focused on the technological outcomes and less on the techniques and adjustments made by researchers. They conclude, as I do, that researchers need to focus on adapting to the individual needs of PwID. Through the co-design workshops, I experienced a process of development, and learned by doing throughout the co-design activities. *CyberSafe* findings show that my experiences and the role of the researcher in co-designing with PwID are multi-dimensional. My role was informed by a number of different factors such as the study context, the codesign exercises, my professional experience, the skills of the graduate designer, and the specific needs of the PwID participants.

A visual and kinesthetic approach was used in the preparation of the session so the learning was in that context. Visual and kinaesthetic approaches to engaging with digital technology occupy an important capability-enabling position within the SST and SJF frameworks, functioning as inclusive design strategies that support meaningful digital participation for PwID. From a capability perspective, engagement modalities that emphasise visual representation, embodied interaction, and hands-on practice enhance individuals' ability to convert digital access into usable skills, confidence, and digital agency (Sen, 1999). On reflection, more time could have been spent on coaching the participants for co-design interactions. Previous literature suggests that researchers have two roles when involving

PwID: 1) support the individual in completing the given tasks, and 2) enable them to actively contribute in design (Gibson *et al.*, 2020). While this literature indicates that a combination of these two strategies is appropriate, my findings indicate that I was solely focused on supporting the participants in completing the given tasks, with the help of support workers present. I needed more facilitators in the co-design sessions. The capability approach emphasises the need to expand individuals' real opportunities to participate meaningfully, rather than merely providing nominal access to participatory spaces (Sen, 1999). Within this framework, facilitation becomes a justice-oriented practice, encompassing communication scaffolding, validation of lived experience as legitimate knowledge, confidence-building, and the active mediation of power relations (Donetto *et al.*, 2015). Such facilitation enables PwID to exercise genuine agency in shaping technological outcomes, thereby supporting substantively inclusive and socially just sociotechnical design processes. However, this was constrained by ethical considerations as discussed earlier. Safari, Wass, and Thygesen (2024) recommend a diverse group of facilitators with complementary skills and knowledge, such as special education teachers, practitioners, and specialists, psychologists and support workers. However, there is a delicate balance as too much support can create a sense of overreliance, which can hinder the autonomy of PwID (Rajapakse *et al.*, 2019). The importance of incorporating principles of respect, self-help, trust, rapport-building and experiential learning was key in this regard. In this way, I gained knowledge about PwID, which informed the design process by utilising very practical creative techniques. This "method story" approach is in contrast to the standard understanding of methods, which typically assumes that such knowledge would be extracted from the results after the method has been used correctly and consistent with the scientific method.

7.4 Research Question 4

Data collected during three lab sessions was analysed to answer the fourth research question; *What usability, satisfaction and engagement issues did this user group report when using the prototype, which was developed using a UCD methodology?*

This research question was broken down into three subcomponents:

- What usability interface problems did participants encounter using the application?

- Did participants engage with the application?
- Were participants satisfied with the application?

Participants interacted with three iterations of the *CyberSafe* prototype, in three separate lab sessions, at different milestones in the application's iterative development. This allowed for more in-depth examination of research question four. For the most part, it was reported that the participants enjoyed interacting with *CyberSafe*, playing the games, and exploring the interactive video and interaction with the scenarios. With refinements over a number of iterations, and as evidenced in the triangulated data from the lab sessions, the application became more usable, useful and satisfying for the participants to use. The results showed that:

1. The application was usable and useful. It is encouraging for *CyberSafe* that so few incidences of frustration were recorded. Although one participant with reading challenges needed assistance to read the questions, nearly everyone found the navigation easy to use and the application easy to understand. Intuitive features such as the clear menu structures and minimal scrolling were found to facilitate navigation.
2. The application was engaging to use. The learning process was enjoyable. Positive enjoyment and engagement results were reported. The majority of participants reported that the *CyberSafe* prototype was engaging to use, and this mirrors the findings of the observational and co-design workshop data.
3. The participants were satisfied with the application. Participants were very vocal and greatly appreciated application feedback, progress bars and positive encouragement for both correct and incorrect answers. Participants were generally very happy with the application.

7.4.1 Meta Theme of Engagement

With regard to engagement in the lab sessions, indices of behaviour by persons with ID are consistent with, and can be measured reliably, based on typically developing individuals (Darling and Circo, 2015). While there were limited navigations issues encountered, what was evident was enjoyment and engagement in a novel experience interacting with the *CyberSafe* educational application in the lab sessions. The resulting benefits of learning were evident and included:

- discovering what worked in a participatory context for this user group,
- powerful impact of inclusion on participants
- a physical prototype to represent the collaborative work.

All participants in this *CyberSafe* study completed the tasks assigned. No participant showed signs of boredom such as sighing etc. and there were primarily positive vocalisations with no negative vocalisations recorded or coded. A number of participants cheered when answering questions within the game correctly. One participant with reading difficulties let out a sigh when struggling with reading. Participant's propensity to think aloud allowed for the measurement of other affective states like interest and fun. It was possible to measure cognitive engagement, in the lab sessions, by checking whether the user completed the intended task within the interface using the Camtasia recordings. Cognitive engagement was high which demonstrated that engaging with *CyberSafe* could improve the user's experience and assist them in achieving their goals of learning about cybersafety (Doherty *et al.*, 2018). Engagement potential increased when cognitive strain was reduced while the participants were navigating the interface. This was accomplished for *CyberSafe* by incorporating images, video, interactivity, and audio output, and eliminating the use of text whenever possible (Lányi, Brown and Standen *et al.*, 2012).

Participants experienced delight and user satisfaction when interacting with *CyberSafe*, which shows that delight and satisfaction are relevant to engagement. This echoes with findings from Judge (2010) who, in the study of initial interactive whiteboard usage in Irish schools, found that the board's interactive affordance capabilities made learning more enjoyable and engaging for students. The elements of the *CyberSafe* prototype that the

participants found most engaging were the game-style elements. This aligns with a study by Lányi *et al.* (2012), who highlighted the importance of incorporating such elements into interfaces for PWID to heighten engagement. Increased engagement means the user is more likely to return to the interface, and repeating the activities consolidates learning. Increased engagement is one of the outcomes of educational games for PWID. This was evidenced in the lab sessions where the most popular game element was the interactive Coin game that invited the participants to click the correct answer about a friend request on Facebook to win a coin. The Coin game, with the interactive metaphor design of the coins appearing on the screen as participants answered correctly, enhanced participant engagement. The Coin game was the most popular and the favourite of the lab exercises, with several participants replaying the coin game several times. Participants displayed joyful verbalisations each time that they completed it and won five coins. *CyberSafe's* data aligns with research that adults with ID demonstrate more engagement-related behaviours when interacting with the games-based content (Kwon and Lee, 2016). Engagement was increased when the five virtual coins were supplemented with real gold coloured chocolate coins, in the final lab session, linking the virtual and the real world. PWID benefit from the visual modality when it comes to memory and comprehension. Future research could explore the effect on learning of this link in terms of engagement. The participants remarked that they would like more game components.

This *CyberSafe* study also suggests that skill improvement should be rewarded for PWID. Badges were employed to achieve this objective in *CyberSafe*. Positive engagement was achieved through badges in the quiz components and Coin game. Badges were selected in the first co-design exercise by the participants as their reward symbol of choice. The participants demonstrated interest and completed all five tasks assigned. The participants were observed engaging positively with the application. The Coin game offered resources for empowerment and motivation to win more coins as backed by research by Kwon and Lee (2016). It was not within the scope of this research study to add varying ability levels to the game to support the participants' engagement and learning. In conclusion, there were many more positive aspects than negative in the user experiences of using *CyberSafe*. The negative aspects were for the most part easily fixed, e.g., minor navigation issues.

7.5 Research Question 5

- What UCD guidelines/toolkit could this study produce for the greater educational community, when designing for PwID?

Since this Ph. D research study began, PwID are becoming more involved in the design of technology interfaces such as web applications (Bayor *et al.*, 2021), learning applications (Raman and French, 2021), digital e-learning platforms (Murphy *et al.*, 2024), and tangible technologies (Bircanin *et al.*, 2021). In designing with PwID, participatory design is the most common approach. This approach is characterised by direct contact with PwID during the application design process. The user-centred design approach has been less utilised because of the challenges, described by Edler (2020) and outlined in Chapter 3. This present *CyberSafe* study investigated Edler's recommendations (Edler, 2020). The EU Easy Reading project (2017-2020) employed the participatory UCD approach as a framework for inclusive research and development (See <https://www.easyreading.eu/the-project/>). These tools and methodologies were examined in the context of this *CyberSafe* study. A full adaptation of the participatory UCD approach was beyond the scope of this study, but I employed those that were appropriate to the study and adopted as many of the recommendations as feasible to contribute a scaled down single-study-based workable UCD toolkit for PwID to the wider research community. *CyberSafe*'s findings demonstrate the various complex angles for researchers to consider in user centered design activities with PwID. Throughout the user centered design methodology adopted by *CyberSafe*, young PwID were involved in mapping their needs and lived experiences, exploring ideas, prototyping concepts, testing and refining a proof of concept, and testing the final prototype. Methods and tools to demonstrate how this was achieved have been described. Insights on a contextual and customised approach to co-design with young PwID were presented in the previous discussion section. Conclusions and thoughts on the circumstances that made it possible for young people to truly participate, were discussed, including the positive effects felt by participants. The aim of research question five is to share important insights and concepts about how to encourage true participation in the format of a toolkit for UCD for this target cohort.

This thesis proposes the following toolkit entitled *CyberSafe's Toolkit for User Centered Design with PwID*. The toolkit describes recommended best practice for user centered design with users with ID under four different headings:

1. Research
2. Methods
3. Tools
4. Content Design

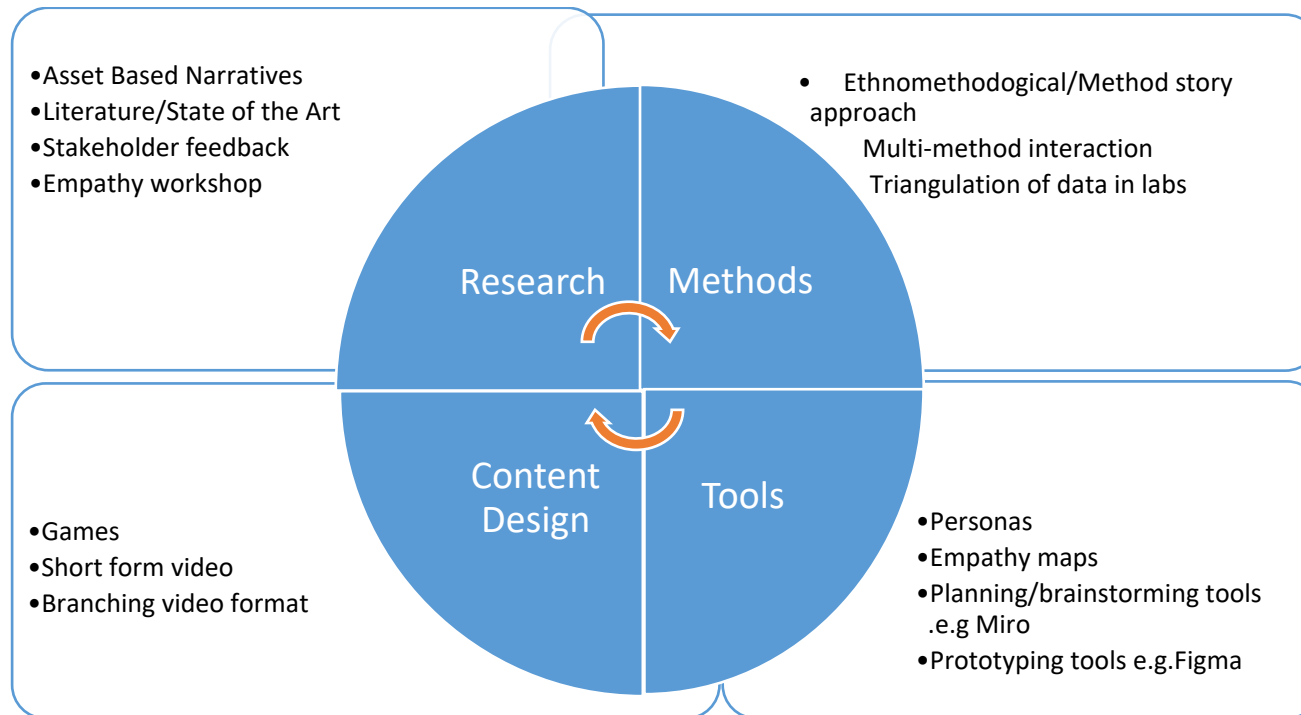


Figure 55 Cybersafe's Toolkit for User Centered Design with PwID.

Each of these four quadrants represented by Figure 56 and their key concepts and recommendations will be discussed in the context of their effectiveness in the overall user centered design process for *CyberSafe*.

7.5.1 Quadrant 1: Research

7.5.1.1 Asset based narratives

CyberSafe's toolkit emphasises the significance of contextual preparation by embedding asset-based narratives to empower young people and support expression of voice, fostering creativity and conceptual decision-making. Asset-based narratives focus on the strengths, not the deficits of the participants. This is similar to Bayor *et al.* (2021) competencies approach for PwID where they identified competencies, which were representative practical skills people develop from their participation in life activities, in particular, mainstream technologies, such as social media and the Internet. The emphasis is on the importance of taking strengths-based approaches that offer flexible response options so that participants can use their self-determined competencies to complete design activities. It encourages an approach that gives PwID agency and credit for their expertise and positions PwID as co-constructors of knowledge, not merely as individuals in need of a service provided by outsiders. Applied to cybersafety education, Bell's framework (2016) highlights the importance of participation, agency, and empowerment. An asset-based approach encourages active participation instead of passive reception. *CyberSafe's* findings challenge deficit-based assumptions that frame PwID primarily as passive or incapable digital users. Instead, participants demonstrated active engagement, curiosity, and decision-making when technologies were shaped around their needs and experiences which reflect SST emphasis on technology as socially constructed through human practices, values, and power relations rather than as a neutral or deterministic force (Williams and Edge, 1996; Winner, 1980). *CyberSafe* proposes this asset-based approach as an emerging idea supported by a rights-based ethos, together with insights and reflections, with a focus on establishing the ideal environment and building the necessary skills to enable meaningful participation. *CyberSafe* endorses the view that the codesign and use of digital interfaces and assistive products by PwID offers considerable opportunities for the advancement of

the health of people with ID and the fulfillment of basic human rights. Participants' ability to identify appropriate responses to cyberbullying, blocking, and reporting following engagement with the prototype illustrates how capabilities can be developed when instructional resources are shaped around users' needs. This supports Nussbaum's (2006) argument that justice requires not only formal rights, but practical conditions that enable individuals to exercise those rights.

7.5.1.2 Stakeholder engagement

Stakeholder engagement should be prioritised as a foundational step in any user-centred design (UCD) process targeting people with intellectual disability (PwID). Early collaboration with stakeholders, including support workers, families, educators, and PwID themselves, ensures that diverse perspectives and lived experiences inform the design from the outset. This participatory approach aligns with inclusive design principles and helps overcome assumptions often made by designers without lived experience of disability (Rodgers et al., 2016). In the *CyberSafe* project, the act of externalising internal understandings through collaborative sessions facilitated the sharing of tacit knowledge between the stakeholders and the researcher. This co-production process fostered mutual understanding and guided design decisions toward usability and satisfaction. Such knowledge exchange is especially important when working with PwID, whose communication styles and support needs may be unfamiliar to designers without experience in the field (Lazar et al., 2017). Therefore, toolkits intended to guide UCD with PwID should include structured frameworks for early stakeholder workshops, visual thinking tools, and methods for eliciting non-verbal or tacit knowledge. Embedding stakeholder voices early and throughout the design process enhances not only product usability but also user empowerment.

7.5.1.3 Literature/State of the Art

Prior research on co-design with PwID was reviewed and gaps were identified. These gaps included a lack of methods for involving PwID throughout a co-design process and a lack of instances of genuine participation centered on lived experience and engagement in creative and conceptual decision-making. With an emphasis on the co-design approach, the

experience of creating a cybersafety eLearning tool with young PwID serves as an example of a contextual, customised participatory design strategy for including people during all co-design stages. The literature section of this thesis was complemented by a State of the Art review (see section 3.7.1) which informed how best to incorporate recent design and functionality trends into *CyberSafe*. This was accomplished by compiling a list of similar applications and evaluating aspects of their product's usability, functionality, features and interaction design. In the case of this thesis, this State of the Art section found some common features and some missing functionality in existing instructional applications for ID users in the area of cybersafety. What was missing was an interactive educational application, which combined elements of games, interactive video, graphics and text. This process helped to identify content and features to add to *CyberSafe* to make it unique and distinct from the other applications in its field.

7.5.1.4 Empathy Workshop

Empathy workshops were exploratory in nature and helped to inform knowledge, based on empathy with PwID. As a part of the User-centred design (UCD) process, I employed empathy workshops, which used questions, structured and semi structured. Therefore, I obtained exploratory information and expanded on these areas by asking probing questions typical of unstructured interviews. This had the advantage of highlighting issues that I previously had not considered. The focus needs to be on data collection methods, when in the empathy stage with PwID. Data collection in empathy workshops yielded better data, which is more spontaneous, by removing the stigma and inertia of filling out questionnaires.

7.5.2 Quadrant 2: Methods

7.5.2.1 Ethno-methodological approach

PwID experience marginalisation, as they faced discrimination in education and employment until quite recently. Although PwID experience marginalisation, they have also been excluded from direct involvement in user-centred design teams (Edler, 2020). Researchers, who work with PwID, have proposed a number of adaptations, in recent years, to facilitate autonomy while supporting participation. For example, to support

communication, researchers suggest developing relationships directly with participants and offering graded assistance (Bircanin *et al.*, 2021). Others have produced co-design toolkits for PwID, which adapt common design tools by using simplified language and incorporating visual aids (Riveiri *et al.*, 2022). Aswad *et al.* (2022) highlighted that PwID reported a sense of ownership and enjoyment when they worked directly on teams that employed adapted tools, indicating that results in positive experiences. *CyberSafe's* toolkit adds to this work as it proposes using an ethno-methodological approach as an analytical lens to look at how researchers and designers actually act while creating novel methods in their particular contexts of working with PwID. This *CyberSafe* study highlights the actions associated with employing creative approaches (i.e., the hands-on work of designer and researcher) that are often not described in most methodology definitions. What is frequently missing in current studies and research about designing applications with PwID is an explanation of the kind of methodological adjustments that were made and the rationale for those adjustments. Due to the focus on more formal descriptions of methodology, these practical practices in co-design and user-centred design research have so far received very little attention. As a result, these behaviors were viewed as either being too practical to warrant an explanation or being too context-dependent to be formalised as scientific knowledge. The "method story" approach provides a framework for coming up with concepts that are pertinent to the research objective. The "method story" approach forces the researcher to reflect on their methods and practice, while planning, executing and reporting the findings. This "method story" experience, in the *CyberSafe* co-design workshops, was enlightening as it worked. It worked because PwID know what they like, even if they cannot always communicate the reasons behind their choices. From a background of a positivist and scientific view of method, I now propose that this situated approach at the heart of creative methods benefits designers and researchers i.e., the overall process of a design activity extends beyond conceptions of scientific validity. Situated design describes the challenges, changes and negotiation involved in designing things. It describes "the interactions and interdependencies between designers, designs, design methods, and the use situation with its actors, activities, structures, particulars, and broader context" (Simonsen, Svabo, Strandvad *et al.*, 2012, p.102). Traditional HCI and User Centered Design (UCD) approaches and methods need to be interpreted from different criteria and delivered in different ways

with regard to the local context in which methods are utilised, when working with PwID. Through comparing results and looking for broad guidelines for method modification, a positivist frame seeks to increase the applicability of techniques. However, for creative approaches, I agree with Lee (2014) and recommend telling the story as it actually happens in a specific location and context and why it happens exactly that way. Such stories do not strip away the rich contextual information of their actual usage. *CyberSafe's* toolkit proposes that while working with PwID, method stories will assist UCD researchers in more effectively reflecting upon their selection and use of methods.

7.5.2.2 Multi-method interaction

CyberSafe recommends using a range of modalities and multi-method interaction with participants (e.g., tactile via paper prototyping, digital etc.) for interaction. It was apparent in the research phase that experts supported using a variety of different modalities. Due to their considerable diversity, PwID react to information in a variety of ways. Using workshops that largely rely on a single modality for participant interaction is a weak strategy and may significantly reduce the quantity of feedback that participants give. For instance, because some participants were less at ease in a group setting, in the empathy workshops, they withdrew from the tasks that required more verbal communication. Yet, when interacting with the tactile prototypes, they responded favorably with suggestions. In addition, using a variety of modalities for interaction helps to keep the participant's attention, especially during longer studies.

7.5.2.3 Triangulation of data

The data collection strategy employed in this study significantly enhanced the validity and richness of the insights gained. Working with PwID requires researchers to go beyond conventional methods of data collection and interpretation. This is because PwID may express themselves differently, through gestures, or verbalisation and standard tools may not capture their full range of responses. Therefore, careful attention to how data is gathered, and what counts as data, is essential. In the lab sessions, *CyberSafe* adopted a triangulated method consisting of Camtasia screen recordings, researcher observations, and

an adapted System Usability Scale (SUS) utilising a Smileyometer Likert scale. This multimodal approach addressed the diverse communicative needs of participants, allowing for both qualitative and quantitative dimensions of experience to be captured and validated across sources. The Smileyometer, a visual analogue Likert scale using pictorial faces to convey emotional responses, proved particularly effective in collecting self-reported data from participants with lower literacy or verbal expression levels (Read and MacFarlane, 2006). This method enabled participants to independently express satisfaction, confusion, or enjoyment without requiring complex language, thereby improving the inclusivity of the data collection process. Screen recordings of on-screen behaviour complemented this by offering objective insights into navigation patterns, hesitation, and usability bottlenecks. These were invaluable during thematic and content analysis, helping to contextualise participant feedback with observable behaviour.

Researcher observations provided a third layer of insight, capturing non-verbal communication, social interaction, and the emotional tone of the lab environment. These observations were crucial in identifying subtle but meaningful indicators of engagement, frustration, or confidence, elements often missed in self-report measures alone (Chadwick et al., 2013). This triangulated approach enabled more nuanced interpretations and increased the credibility and trustworthiness of findings (Lincoln and Guba, 1985).

Ultimately, combining these methods allowed the research to better honour the principle of “Nothing About Us, Without Us” by designing a data collection process that adapted to participants’ abilities rather than forcing them to adapt to rigid research tools. It also positioned PwID as active informants of their digital experiences, and not passive subjects, which is an essential stance for inclusive research.

7.5.3 Quadrant 3: Tools

7.5.3.1 Using Visual Tools

An important practice of user-centred design (UCD) is the distillation of user data into visual representations that provide insights into the problem domain. The purpose of employing a visualisation method is not simply to create an image or object; the challenge is to provide relevant information that furthers the design process (Houde and Hill, 1997). The adoption of visualisation methods is recommended as a way to overcome the challenges of

collaborative design (Zimmerman *et al.*, 2007). Visual artefacts can group together relevant information. The diverse and graphical character of social media and the internet itself are indicative of the importance of visualisation as a tool for visual memory and understanding. *CyberSafe* recommends using UCD visual approaches like creating personas, and empathy maps to facilitate a shared understanding of the problem context. The benefits of these visual tools to the user-centred design process were highlighted in the Design chapter. *CyberSafe* recommends adapting prototyping and brainstorming tools like Miro and Figma as they act to elicit information from PwID, which may otherwise be difficult to capture for the project under consideration. Combining the use of tools like Miro, Figma and templates such as the one by McKercher (2020) made what initially seemed like a huge challenge in designing the co-design materials, feasible. As a result, the steps to tackle the challenge began to take shape as the research evolved. In particular, McKercher's visual template highlighted the importance of spending time on building and optimising the right conditions for the empathy and co-design workshops.

Some of the UCD visualisation tools utilised by the *CyberSafe* study included:

- Personas
- Empathy maps
- Planning/brainstorming tools e.g., Miro
- Prototyping tool e.g., Figma.

7.5.4 Quadrant 4: Content

7.5.4.1 Exploration and engagement through games

Young people with ID find learning through a game interface appealing and this was demonstrated in the popularity of the Maze and Coin games elements of the *CyberSafe* application. Compared to commercial off-the-shelf games created for entertainment rather than instruction, there is debate regarding whether proprietary games built for educational objectives can give a more effective digital learning experience (Mayes and de Freitas, 2007). Off-the-shelf games typically fall short in supporting clearly specified learning objectives, although PwID, as reported in *CyberSafe's* empathy workshops, do play and enjoy their design and degree of immersion as they are frequently better than those of their

educationally targeted competitors. It is necessary to address this flaw to maintain interest from PwID and increase the likelihood that an educationally focused game will succeed. A substantial body of research, referenced earlier in the literature review, supports the use of digital game-based learning to meet the educational needs of PwID. From a variety of perspectives and game genres, this substantial body of research outlines a number of fundamental factors that must be taken into account when creating specialised educational digital game-based learning (GBL) tools for PwID (Saridaki and Mourlas, 2013). Researchers contend that in order to solve the memory issues that many young people with learning disabilities experience, one should use a visual aid (like a GBL tool). In the case of *CyberSafe*, this was achieved through the Maze and Coin games. *CyberSafe*, which is focused on internet safety, also offers an environment for repetition, which is shown to improve learning for people with learning disabilities. *CyberSafe's* participants were given the opportunity to repeat the questions and scenarios in both the Maze and Coin games to improve their learning. This would suggest that a more structured behaviouristic learning style is likely more suited to the learning needs of PwID, which is in contrast to the dominant trend in e-learning theory, which favours a more constructivist approach. Providing PwID the opportunity to repeat questions and scenarios within educational games reflects a pedagogical approach aligned with behaviourist principles. This method emphasises reinforcement, repetition, and the gradual shaping of desired responses which are core tenets of behaviourism as articulated by Skinner (1954). In this context, repeated exposure and practice serve as mechanisms to strengthen learning outcomes, particularly for learners who benefit from structured environments and consistent feedback. For PwID, such repetition can enhance memory retention, build confidence, and support the acquisition of foundational skills, making it a more suitable instructional strategy for designers of eLearning applications for PwID. However, this approach stands in contrast to the prevailing constructivist paradigm in eLearning, which prioritises learner autonomy, critical thinking, and the construction of knowledge through exploration and interaction (Jonassen, 1999). Constructivist approaches advocate for open-ended tasks, problem-solving, and personalised learning pathways, elements that may present challenges for some learners with intellectual disabilities without appropriate scaffolding. Thus, while constructivist models dominate much of contemporary digital learning design, the use of behaviourist-

informed strategies such as repetition and reinforcement remains a valuable and often necessary complement when designing inclusive learning experiences for diverse learners. A trial-and-error approach, (e.g., trying different options to questions asked), was adopted by some of *CyberSafe*'s participants, as detected as a subtheme under the Negative Usability theme in the research results. Getting the participants to choose and design their favourite characters for *CyberSafe* was an effective strategy in engaging the participants in the game design process. Future research could evaluate the learning effectiveness for PWID of the Coin and Maze games.

7.5.4.2 Importance of short form videos

In the context of *CyberSafe*, short form videos (between 30 seconds and 1 minute long) were effective in engaging PWID and teaching about privacy on different phone apps. Breaking down the information into steps in short form video format for participants proved to be very engaging and usable. *CyberSafe* recommends using this short form video format in future content creation.

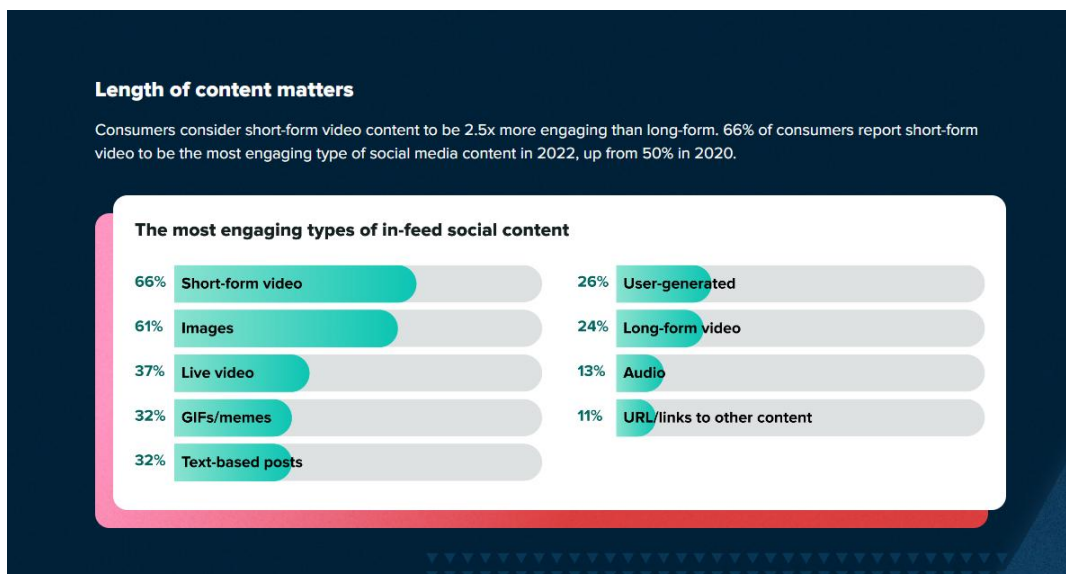


Figure 56 Most engaging content (SproutSocial, 2022)

7.5.4.3 Use branching video scenarios

An interactive video is one that enables viewers to actively engage with the plot, if narrative/drama based, but can just be a different node if not narrative based. Users can

participate in the experience by clicking, choosing, responding to questions, or playing games rather than just passively viewing. In recent years, this emerging research space is opening up in different platforms like games, films and immersive 360 experiences. This space is enabling for storytellers, and is being made possible and accessible with new technology applications. Considering this emerging data and based on the success and popularity of the interactive Catfishing video in the final evaluation stage of *CyberSafe*, this toolkit recommends adopting this interactive video approach in future content creation for this targeted user group. Additional design implementation and research should consider measuring the degree of effectiveness this interactive narrative format has on PwID through the introduction of test questions assessing response motivation. Alternatively, this could be achieved with a conclusive quiz following each branch flow ending. Another future study could assess the relationship between learning outcomes through the medium of interactive video with differing educational themes and topics to decipher the limitations of this learning mode and specify the content type most successfully communicated via this format.

7.5.5 Limitations of the CyberSafe Toolkit

Intellectual disability describes a broad range of people and abilities. This *CyberSafe* study only collaborated with a subset of that group i.e., all of whom had moderate to mild cognitive impairment. A majority of the participants had basic reading, writing, and verbal communication skills. Students were all interested in participating in this Ph.D research study. Therefore, the recommendations of this toolkit should be applied cautiously to people who have different skillsets and interests. The accommodations and activities recommended may need to be reconsidered, or adjusted for different groups of PwID. Future work exploring user-centred design activity modifications to support learning for students with ID is needed to understand how adaptations can best suit PwID. It is worth considering how universal design for learning and co-design values might be aligned to guide activity development in the co-design of educational material for PwID in further education and third level educational settings. Whilst the recommendations presented by *CyberSafe's* Toolkit may not be exhaustive, they can be of benefit to user centered design activities involving users with diverse learning needs, and not just PwID.

7.6 Summary

This *CyberSafe* study explored the digital experiences, challenges, and opportunities faced by people with intellectual disabilities (PwID) in the context of cybersafety and digital literacy. Through a comprehensive user-centred design (UCD) methodology involving stakeholders, support workers, and PwID themselves, the study investigated how to effectively support this population in becoming safer and more confident digital citizens. PwID face persistent barriers to digital inclusion, not only in accessing devices or the internet but in developing the skills and confidence needed to engage meaningfully and safely online. Despite high rates of smartphone ownership and social media use among participants, many lacked the knowledge to use key safety features such as blocking or reporting users. Overprotection or underprotection by families and caregivers further limited digital engagement, reflecting a broader digital lag for PwID. Despite these limitations, PwID expressed enthusiasm about being online and demonstrated a clear desire to learn and improve their digital skills, particularly through interactive and visual tools.

The co-design process proved highly effective in engaging PwID and generating meaningful, user-informed insights. Participants responded positively to multimodal learning approaches, including videos, games, and paper-based prototyping, which allowed them to express their preferences, co-create content, and enhance their learning through visual and tactile interaction. The role of support workers was shown to be significant in mediating communication, facilitating understanding, and supporting meaningful participation in both discussion, co-design and lab activities.

At a broader level, *CyberSafe* calls for the integration of digital literacy and cybersafety training into secondary and special education curricula, supported by tailored, cognitively accessible materials. It advocates for national policy reforms that move beyond infrastructure provision to embrace inclusive, rights-based digital education. The study offers a practical *User-Centred Design Toolkit for PwID*, providing best practices and actionable recommendations for educators, service providers, and designers working in this space.

8. CONCLUSION

8.1 Summary

In conclusion, this research study produced insights into the main issues around cybersafety from the point of view of stakeholders and PwID themselves. Specific key insights which emerged included digital literacy gaps in the area of managing privacy settings, cyberbullying risks and vulnerability to celebrity catfishing. The objective to codesign a cybersafety application called *CyberSafe* for young PwID using a user-centred design methodology was achieved. This study produced an eLearning prototype application that was engaging and easy to use to teach young PwID about cybersafety by utilising a variety of media forms e.g., video, audio and games in its design. The goal was to design and present the cybersafety material effectively to PwID in an engaging manner, to enable them to become champions and promote it in their organisations. This research study produced a number of recommendations for the user centered design of educational applications for PwID, such as the use of step-by-step videos, interactive exercises and interactive video, to enhance accessibility, engagement and usability for PwID. This has extended research into interface design characteristics for PwID covered in existing guidelines and literature. The user-centred design methodology resulted in a rich and engaging experience for the PwID involved. Not only did PwID receive a sense of inclusion and participation in society, but they also give valuable feedback about usability, accessibility and learning preferences. The *CyberSafe* workshops demonstrated that the user-centred design process especially helped illuminate various aspects of content and design that researchers would not be able to determine alone such as the phenomena of PwID being more likely to accept a request from a celebrity they admire. Designing with both participants and support workers helped in the *CyberSafe* workshops to alleviate the communication gap some researchers may struggle with due to their limited exposure to PwID and their lived experience. In this way, early content design flaws were eliminated during the design process as opposed to post implementation, thus becoming a heuristic afterthought.

8.2 Theoretical and Practical implications

There are a number of theoretical and practical implications from the findings of the present study. This current research contributes to the literature within the area of human-computer interaction (HCI) while adding originality through the involvement of PwID, a population often overlooked in HCI. As noted by Preece, Sharp, and Rogers (2019), placing PwID as the centre of development ensures an application can be well-designed based on identified skills and judgements. Understanding identified needs and challenges informed the process of design to create an appropriate instructional resource with value for PwID, engaging them, to protect themselves from the negative consequences of cybervictimisation. The observational analysis provided rich information regarding the nature of any usability difficulties and sources of participants' emotional responses.

This study has provided further evidence that the use of prototypes, in particular digital prototypes, deepens the engagement of PwID in co-design activities (Sitbon *et al.*, 2017; Aswad *et al.*, 2022). While previous HCI studies have acknowledged the importance of inclusive design and participatory methods (Benton and Johnson, 2015), many have primarily focused on minimal involvement of PwID or relied heavily on researcher-led processes. In contrast, this study's co-design workshops emphasised deeper, sustained engagement through iterative prototyping utilising the user-centred design process and facilitating communication at each stage. A key finding was that effective communication remains central to achieving productive outcomes when working with PwID. By adopting an authentically collaborative approach that fosters equality and inclusivity, the *CyberSafe* project demonstrated how the role of the support worker is critical, not just as a facilitator, but as a bridge to understanding and expression. This nuanced recognition of support roles and communication dynamics represents a shift from traditional HCI approaches, offering a more holistic and empowering model of co-design and user-centred design with marginalised communities. *CyberSafe* is contributing to the literature an archetype of "successful" user-centred design for PwID, in the form of the production of a comprehensive toolkit. The production of a tangible, practical toolkit that places the co-designers at the heart of the user centred design process, ensures subsequent follow up and impact.

This present *CyberSafe* study is situated in the wider Digital Literacy skills (DLS) debate for PwID. This suggests that for effective administration of DLS training, support workers and their role must be carefully considered. Longitudinal studies exploring the effect of digital education for PwID over time should be explored to identify more potential benefits to this practice. This research could then inform government policy on how to implement DLS training in education systems. The potential of targeted educational applications like *CyberSafe* to help bridge the digital divide and to support ID services deal with complicated safety and exploitation issues, will also need to be better understood for future development. It is important to monitor any change in PwID perceptions of their own vulnerability on the web and in social media. Relevant government departmental support, digital education, creativity and problem solving are required to secure and protect PwID's human right to bridge that digital divide now and in the future. At the practical and organisational level of ID service providers when it comes to bridging the digital divide and cybersafety, this research study has the following recommendations:

- Educational applications should be designed for service providers and for the needs of PwID (e.g., plain language, use of videos and games).
- Support workers need to be made aware of their special role of primary support for technology usage by PwID. They need further education to learn about current digital developments, suitable educational applications for PwID, and solutions for common problems or challenges.
- PwID likewise need more knowledge about helpful apps and other digital possibilities to enhance their media literacy and to benefit their everyday life.
- Codes of Practice for the usage of the internet in service provider organisations need to be developed.

By framing digital literacy as a human right, this study contributes to the global conversation on equitable access to technology. It provides a replicable model for inclusive educational application design and calls for greater policy attention to the emotional, cognitive, and social dimensions of digital inclusion for PwID. The findings of the *CyberSafe* study contribute to global digital inclusion discourse and align with international efforts to promote equitable access to technology for people with disabilities i.e. United Nations

Convention on the Rights of Persons with Disabilities (UNCRPD) (United Nations, 2006) and the OECD's Digital Inclusion Framework (OECD, 2021). Despite these frameworks, people with intellectual disabilities (PwID) continue to face systemic barriers in accessing digital resources, education, and support (Caton and Chapman, 2016). The *CyberSafe* research and prototype demonstrate how co-designed, inclusive educational tools can empower PwID to navigate the digital world more safely and confidently, while also recognising the essential role of support workers in this process. This underscores the need for digital literacy interventions that go beyond technical skills, addressing broader social and communicative supports (Seale, 2014). By foregrounding communication, collaboration, and tailored design, this study reflects the call for inclusive digital practices articulated in global digital inclusion policies (World Health Organisation, 2022). Feenberg's (1999) concept of democratic rationalisation emphasises the importance of inclusive participation and the involvement of diverse social groups in shaping technological systems, thereby enabling marginalised voices to influence technological outcomes. From this perspective, social justice is advanced when collaborative and democratic practices guide technological development, allowing both individuals and communities to exercise agency in shaping social and technological change. The results highlight a critical need for policy makers, educators, and service providers to develop and implement inclusive, accessible digital literacy programs that account for the unique needs and contributions of PwID. This study offers a replicable model for how bottom-up, community-based interventions can potentially inform broader systemic change. As such, it contributes to a growing body of research advocating for a more inclusive and rights-based approach to digital participation which is an imperative in an increasingly digital world.

8.3 Strengths and Limitations of the Present Study

The present study has a number of strengths and limitations. A major strength is the involvement of PwID in the design process of an educational application targeting this user group as it allowed their voices be heard. Another strength is its user-centred design approach and multidisciplinary collaboration, involving a graphic designer and various stakeholders including PwID throughout the design process and testing activities. The qualitative and inclusive approach focused on a modest but diverse participant sample to

gain a deeper understanding of their various needs rather than a large sample (Patton, 2014). The strength of this qualitative approach lies in the depth of insights gained through repeated interactions with participants across multiple iterations. This study demonstrated that design and testing should not be viewed as separate phases, since valuable input for optimising the design can still be collected during testing phases (van Calis *et al.*, 2025). The feedback gathered during the lab testing sessions helped to refine key design elements, emphasising the value of the iterative nature of user-centered design. The seamless design and testing phases offered greater buy in and engagement with the application by the target user group as they could see the characters and colour schemes, they chose being implemented in the various *CyberSafe* iterations for testing.

The methods employed in the present study had limitations. As previously stated in the Introduction chapter, the exact level of ID for each participant was not known, for ethical reasons. Mild and moderate ID participants were combined in this study due to the ethical restrictions encountered in distinguishing the two groups. The primary aim was to ensure a diverse representation of PwID since both groups are underrepresented in educational and scientific research. It must be acknowledged, that differences between these groups may exist and could have lead to distinct needs affecting the generalisability of the findings. To gain deeper insights into specific design preferences, future research to explore these groups separately is recommended. Using a larger sample and quantitative analysis could give a better evaluation of *CyberSafe*'s usability and engagement. A lack of methods and tools exists for including PwID, in particular, due to barriers raised by complex communication issues. For example, some participants, who may have liked to participate in this *CyberSafe* study may have needed speech therapists involved as well as alternative and augmented communications devices and software to facilitate their engagement. *CyberSafe* lacked the resources to provide these therapists and devices. As a result, the participants in this study had to meet exclusion criteria: sufficient verbal communication skills to express views while using the prototype and participating in the workshop group. Due to the absence of Speech and Language Therapy support, this requirement was necessary to avoid potential frustration should participants without such skills be unable to express themselves during the study.

Individual interviews could have provided a richer understanding of the experiences of PwID that are directly related to bullying and cyberbullying. A semi-structured interview is guided but still informal and can provide “more realistic information on the interviewee’s own terms” (Coolican, 2004, p. 155). Audio recording of the empathy workshop did capture the richness of the workshop data. However, video recording of interviews and lab observation sessions would have provided a record of non-verbal communication and further analysis of responses to the application that are missed through audio and screen capture recordings alone.

One of the biggest obstacles to this kind of research is the ethical challenge of conducting studies with PwID. The breadth and depth of individual differences and accompanying co-morbidities make it challenging to design practical studies (Mulhall *et al.*, 2020). Alongside this, the cost of research can be a big barrier. Costs will remain high unless it is prioritised more, and relevant government bodies, designers and industry become invested in the universal design (UD) approach. The last major obstacle is time. It takes a significant amount of research and work to develop an application and incorporating the needs of every potential individual would require serious and focused effort and investment from a variety of stakeholders.

Another limitation of this research is that inter-rater reliability was not determined for the researcher observational data due to ethical approval from St. John of God allowing just one observer in the lab i.e., the researcher. I was conscious not to overcrowd the participants in the lab sessions during their interaction with *CyberSafe*. However, the screen recordings, captured by Camtasia software, were used as a validator of observed errors. Additionally, the validity of responses on the adapted System Usability Scale (SUS) sheets is uncertain as it is unknown whether the responses reflect the actual thoughts and experiences of PwID participants. Responses collected may be inaccurate due to the tendency of this population to please those perceived as authority figures (Cáliz *et al.*, 2017; D'Eath *et al.*, 2005). However accompanying support workers who knew the participants well, helped to ameliorate this response bias effect.

8.4 Future work

To bridge the digital divide, further study is required into how restriction in internet access for PwID is managed and negotiated, when there are potential risks online. Consideration of how such negotiation interacts with self-determination, human rights and the provision of person-centered support to young adults with ID is an area for future study. A study of differences in digital restrictions between older adults and young adults with and without intellectual disabilities could further determine whether discrepancies in self-determination do exist. Further research should explore how to provide sensitive support and resilience training around online risk to PwID. In order to address the digital divide, future work is needed to explore the complex overlapping of safeguarding, self-determination from a human rights perspective, positive risk taking and online participation for PwID in this current online world. As one expert stakeholder said *“if we're not allowed that freedom, then we're never going to learn and we're always going to be ‘protecting’ as opposed to empowering” (EP3)*.

The next step for *CyberSafe* is for it to be developed from a prototype to a live version, complete with extra features in order for the research to be fully fruitful and have an impact. The results of this research study will inform recommendations for future development of *CyberSafe* to increase the accessibility of the application for PwID. As this was a study, in conjunction with an outside agency and a vulnerable user group, ethical considerations were a priority. The sample size was small. Therefore, the data analysis was of a qualitative nature. Future research could involve a larger sample, with quantitative analysis yielding an enhanced evaluation of the effectiveness of *CyberSafe* as an eLearning tool. The time spent testing the participants' usability and engagement issues was limited, to avoid any undue distress for PwID. For ethical reasons, there was no opportunity to video record participants' expressions but their interactions with the prototype were screen captured. It was evident that the participants found the prototype easy to use. They liked the application, which they had helped to design. In order for the finished application to function as an effective learning tool, a high level of user engagement is recommended. Skill levels could be used to challenge and engage users, and an adaptable system could give the user more control. Introducing levels to the application would allow for age appropriate or

stage appropriate skill development to support independence and social interaction. This research study could also be further extended by exploring the different power structures between researcher, support workers and PwID. This would be important if the user-centred design activities are conducted over a period of time as power structures may change over time. In addition, in line with the “*Nothing about Us, Without Us*” movement, there is a need for more research on the involvement of PwID in design teams as facilitators. Such research could support increased inclusion and diversity in design teams and provide knowledge on the empowerment of PwID.

Further research is necessary to identify the precise factors that contribute to usable and engaging designs with this user group. Some young adults with ID are adept at smartphone games and use popular social media sites. Inspiration could be drawn from current interface design trends to offer an even trendier and more visually appealing product. Dekelver *et al.* (2015) urge designers to ensure consistency in graphic design and navigation throughout the interface. Future iterations of *CyberSafe* could incorporate recommended guidelines by Daems *et al.* (2016), who stress the importance of providing in-app assistance to persons with ID.

In the context of the finding around interactive videos and PwID engagement, future design research should consider measuring the degree of effectiveness this interactive narrative format has on the target user population. This could be achieved through the introduction of test questions assessing response motivation, or perhaps alternatively this could be achieved with a conclusive quiz proceeding each flow ending. A future study could also assess the relationship between learning outcomes through the medium of interactive video with differing educational themes and topics to decipher the limitations of this learning model for PwID and specify the content type most successfully communicated via this medium. There could also be a focus on a more step by step approach (Skinner, 1954) to e-learning design for PwID.

Since this research study began, artificial intelligence (AI) is now contributing to progressing inclusive education by providing various tools and solutions tailored to individual learning requirements, improving communication, and encouraging increased participation for people with cognitive disabilities. AI is increasingly being recognised for its

potential to drive transformative changes across various domains, particularly in enhancing accessibility and inclusivity for individuals with cognitive disabilities. There is a gap in the current literature regarding using artificial intelligence in supporting the education of students with ID. AI gives an advantage to researchers, developers, and users with and without intellectual disabilities alike as researchers can better assess how products are used. During studies, developers can incorporate data quicker, training the AI to adapt the software interface in real-time, to the needs of PwID. The need of personalisation is met with the product adapting to the user and costs can be significantly reduced overall. This is where AI can be incredibly useful. Further research is needed into the capabilities and potential of AI for improving accessibility for individuals with cognitive disabilities like PwID. Future research should gather information about AI technology directly from PwID, aim to build algorithms that adapt interfaces and experiences in real time based on users' needs, and create prototypes to aid in automating accessibility testing. As AI technology progresses, it is crucial that these algorithms are developed with sufficient input from individuals with ID. This will ensure that they are effective in meeting their needs, exclude potential biases and promote inclusion.

8.5 Conclusion

For PwID, it is important that a digital educational interface is engaging and usable. Employing a user-centred and user-sensitive design approach for the design of *CyberSafe*, to enhance accessibility and usability, helped identify design characteristics and elements specifically important for PwID, based on feedback from participants involved in the application's codesign and testing processes. This study extended fundamental design characteristics covered in existing guidelines and literature, such as the use of step-by-step videos, interactive video and interactive exercises to enhance accessibility, engagement and usability for PwID. Three key contributions resulted from this study comprising:

- (a) a wide range of insights related to cybersafety for PwID, such as their vulnerability to celebrity catfishing and how risk exposure can result in positive personal growth;

- (b) a usable educational prototype application called *CyberSafe* which incorporated text, graphics, games and interactive video elements, was created; and
- (c) a toolkit of recommendations was produced that can be used to guide researchers through the process of user-centred design for PwID.

Meaningful participation by PwID as participants, co-designers, or co-researchers are essential at all stages of the user-centred design and research process (Aswad et al., 2022). Traditional research methods, which often rely on verbal communication (e.g., in one-on-one interviews or brainstorming in focus groups) about abstract concepts, may be insufficient for obtaining a full understanding of their needs. Using flexible methods and realistic-like situations, for example, having group discussions using a prototype or providing feedback on multiple mock-ups in codesign workshops, enables participants to conceptualise and reason their actions or preferences because they can identify and empathise with reality (Dekelver *et al.*, 2015). Therefore, *CyberSafe* has demonstrated that using participatory methods with flexible and adaptive approaches are well-suited to placing the participants at the center of the design or research process (Rus *et al.*, 2017). In conclusion, by adopting a user-centered design approach and incorporating key design characteristics and elements identified through the research process, digital educational applications can be tailored to meet the diverse needs of individuals with PwID, facilitating greater inclusion and participation in digital society. It is vital that researchers, relevant government departments, educators, technology developers, IT organisations and PwID work together to create inclusive solutions, define workable ethical frameworks and ensure digital technologies are accessible and meet the needs of PwID. There is still very limited research on how individuals with an intellectual disability engage with digital educational applications with regard to their preferences, challenges and the interface types which are most effective. Future research should continue to explore intellectual disability and digital literacy, with a focus on cybersafety and digital citizenship.

To bridge the digital divide for PwID, it is vital to guarantee universal and equitable access to technology, irrespective of socioeconomic status, geographical location, cultural background, or support needs (Van Dijk, 2005). While access is a foundational requirement, it must be accompanied by the right conditions for meaningful use, including ongoing

training, accessible content, and personalised support (Chadwick *et al.*, 2013; Salmerón *et al.*, 2020). This means that initiatives should not only provide devices and connectivity but also foster environments where PwID can engage with technology confidently, safely, and autonomously. Equally important is the need to adopt a user-centred design approach, one that actively involves PwID in the creation, testing, and refinement of digital tools (Edler, 2020). By incorporating key design principles such as simplicity, interactivity, visual scaffolding, and customisation, characteristics supported by research on multimedia learning (Noetel *et al.*, 2021; Barman and Jena, 2023), educational and assistive technologies can be better tailored to meet the diverse cognitive, social, and emotional needs of PwID.

Inclusive design is not just about accessibility, it is about empowerment, participation, and agency (Seale *et al.*, 2017; Bell, 2016). The pursuit of a more inclusive digital society for PwID is a dynamic and evolving area of research, with significant implications for education, employment, communication, and self-advocacy (Goggin and Newell, 2003). As digital tools increasingly mediate access to rights, services, and community participation, closing this gap becomes more urgent. Bridging the digital divide, or more accurately, addressing the digital lag, will require ongoing collaborative efforts across sectors: designers, educators, support workers, disability advocates, policy makers, families, and most importantly, PwID themselves (Chadwick and Quinn, 2021). This inclusive, multi-stakeholder approach ensures that interventions are not only technically sound but socially and culturally responsive, creating a digital landscape where all individuals, regardless of intellectual ability, can thrive. Future research should continue to explore how co-designed, real-world digital solutions can support lifelong learning, digital agency and citizenship, and digital independence for PwID. Overall, these findings support the need for a more nuanced, individualised digital inclusion policy, one that takes into account not just the technological and structural dimensions of the digital divide, but also the cognitive, emotional, and social realities faced by PwID. The search for a more inclusive society in this dynamic digital world for PwID is an exciting area for further study. Bridging the digital gap or lag for PwID will require a continued collaborative effort.

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APPENDICES

Appendix A: Accessible Information and Consent documents



Participant Information Leaflet

Study title: *CyberSafe*

Researcher's name:

Marian McDonnell

Telephone number of principal investigator:

086 3392040

You are being invited to take part in a research study to be carried out at SJOGCS or by Dublin City University's principal investigator Ph.D candidate Marian McDonnell with her teacher Dr Miriam Judge.

PLEASE TICK in the empty box if you understand


A magnifying glass with a black handle and frame is positioned over a bar chart. The chart has three blue bars of increasing height from left to right, with a red line graph showing an upward trend.	You are invited to take part in a research study.	
--	---	--

Before you decide whether or not you wish to take part, you should read the information provided below carefully and, if you wish, discuss it with your family, or friends or decision assister. Take time to ask questions – don't feel rushed and don't feel under pressure to make a quick decision.

You should clearly understand the risks and benefits of taking part in this study so that you can make a decision that is right for you. This process is known as 'Informed Consent'. You don't have to take part in this study. If you decide not to take part it won't affect your future care.

You can change your mind about taking part in the study any time you like. Even if the study has started, you can still opt out. You don't have to give us a reason. If you do opt out, rest assured it won't affect the quality of treatment you get in the future.

PLEASE TICK

	You are invited to take part because you like computers and phone apps.	
---	---	--

Why is this study being done?

You are being invited to take part in a research project into safety on the internet. A research project is a way to learn more about something. The purpose of this study is to find out your experience about staying safe when using phone apps and computers and designing an app to teach you and your friends how to stay safe.



You will have to use a computer. What you say about how you use the computer and apps on your phone will be recorded and written down on paper.

Who is organising and funding this study?

I, Marian McDonnell, am doing this research as part of my studies at Dublin City University, who are funding the research.

	Marian will write what you think and say in a report.	
	You will use the computer for a maximum of 30 minutes at the workshops.	
	You can stop at any time.	







You can talk about using the app.


What will happen to me if I agree to take part?

The first time, I will ask you some questions about your experience using apps like YOUTUBE, WhatsApp, and Facebook. This is called a focus group. Then, you will get a tour of IADT's film and animation studios. This will take 1 and half hours in total.

The second time you attend, I will also ask you , in a group with 5 other students, to pick your favourite characters or draw and design your own for a game or choose some backgrounds for a new computer and phone app called *CyberSafe*.

The third time, you will be in a group with 5 other students who will also be using our early stage app called *CyberSafe* using the characters you designed. You will answer some questions about whether you like it or not or what you find easy or hard to use in the app. You do not have to answer any questions that you don't want to. These 3 sessions in IADT College will take 5 hours all together.

	<p>Video/and or Audio recordings?</p> <p>What you say will be recorded in an audio file and written down on paper.</p>	
	<p>There will be someone to take you home if you want to leave.</p>	
	<p>Marian can take out anything you say up until the time the report is written.</p>	
	<p>Is the study confidential?</p> <p>Anything you say or write will not be shared with your name attached, as your data is private.</p>	

	<p>All of your data will be kept confidential under the limitations of the law. However, if during our conversation I hear anything which makes me worried that you might be in danger of harm, I might have to tell other people who need to know about this.</p>	
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CONSENT FORM

Research Title: *CyberSafe: User Experience Design of a cybersafety educational application for young adults with mild/moderate Intellectual Disability.*

What is the *CyberSafe* about?

Research tells us that bullying of people who have an intellectual disability (ID) is a very serious problem and needs to stop.

In the *CyberSafe* project, we will help people learn about how to stay safe online






PLEASE TICK

I have read the information sheet for this project.



Yes
No

	<p>This is Marian the Principal Investigator in this study.</p> <p>Marian is undertaking this study in partial fulfillment of a doctoral degree.</p>	
	<p>Marian will write what you think and say in a report.</p>	
	<p>How will the study be carried out?</p> <p>If you decide to take part, you will be asked to attend the Institute of Art, Design and Technology (IADT) College in Dun Laoghaire 3.</p>	

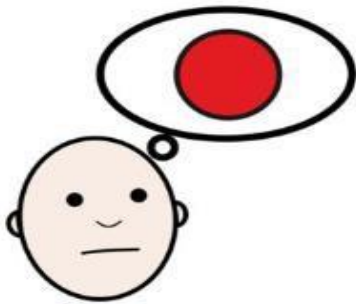
The project was explained to me by

My Key Worker



Yes
No

I had the chance to ask questions
and talk about the project



Yes
No

I understand that
this is my choice
to take part in the
Project



Yes
No

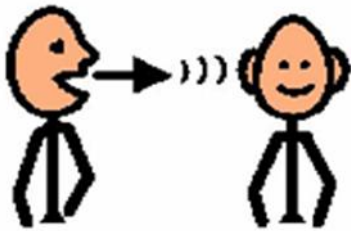


I understand that I can stop helping with the project at any time. This won't make any difference to the services I get from Saint John of God.



Yes

No



The team has talked to me about the focus group and design workshops.



Yes

No








I was able to ask questions about the focus group.



Yes

No

	<p>I understand what the focus group is about.</p>	 <div style="border: 1px solid black; padding: 5px; display: flex; justify-content: space-around;"> Yes <input type="checkbox"/> No <input type="checkbox"/> </div>
	<p>I understand that I can say yes or no.</p>	<div style="border: 1px solid black; padding: 5px; display: flex; justify-content: space-around;"> Yes <input type="checkbox"/> No <input type="checkbox"/> </div>
	<p>I understand how I use the computer will be written down.</p>	<div style="border: 1px solid black; padding: 5px; display: flex; justify-content: space-around;"> Yes <input type="checkbox"/> No <input type="checkbox"/> </div>
	<p>I understand that what I say in the focus group will be audio recorded and written down on paper</p>	<div style="border: 1px solid black; padding: 5px; display: flex; justify-content: space-around;"> Yes <input type="checkbox"/> No <input type="checkbox"/> </div>

Signed: _____


Date: _____

To be completed by the Principal Investigator or nominee.

I, the undersigned, have taken the time to fully explain to the above patient/service user the nature and purpose of this study in a way that they could understand. I have explained the risks involved as well as the possible benefits. I have invited them to ask questions on any aspect of the study that concerned them.

-----Name
(Block Capitals) | Qualifications | Signature | Date

Contact Details of Researcher: **Marian McDonnell**

	marian.mcdonnell@iadt.ie	
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Appendix B: Final expert stakeholder interview protocol

The 12 interview questions for the 4 interviewee stakeholders included:

1. What are the biggest benefits for ID users being online?
2. Have you seen any examples of the internet impacting the lives of young adults with ID? If yes, give an example.
3. What are the biggest obstacles ID users face in accessing the online environment?
4. What are the biggest obstacles ID users face interacting online?
5. What are the biggest risks facing users in an online environment?
6. In your opinion, do benefits outweigh the risks?
7. Is there a lack of awareness about internet safety among ID users/carers/teachers?
 - a. If yes, what could help increase awareness?
8. Do you think current educational resources are appropriate? Why/Why not?
9. Are current cyberbullying supports accessible to people with ID?
10. What would you like to see implemented to help ID users with cyberbullying?
11. What information would you like to see covered in a training course for users?
12. What type of educational supports do ID users need to cope with cyberbullying




Appendix C: Stakeholder online survey

<https://forms.office.com/e/UCBnLrFqtC>

Appendix D: Empathy workshop questions

Empathy Workshop QUESTIONNAIRE

CyberSafe Empathy Workshop

	<p>How often do you go on Facebook/WhatsApp, YouTube, Instagram or Snapchat?</p>
	<p>Can you describe the difference between a stranger and a real friend online?</p>
	<p>When you use Facebook/WhatsApp/Instagram/Snapchat, have people you haven't met tried to be your friend?</p>



Would you accept friendship requests on Facebook/WhatsApp/Instagram/Snapchat from people that are strangers?



Do you know about privacy settings on Facebook/WhatsApp, Instagram or Snapchat?



What can you do to stay safe on Facebook /WhatsApp, Instagram and Snapchat?



Do you know that bullying is?



Have you ever seen someone being bullied online?



Have you ever seen anyone being bullied face to face?



Can you describe what you have seen?



If you saw someone being bullied, what advice would you give them?

Sample co-design tasks for workshop 1

1. Which character is your favourite for a game about internet safety?

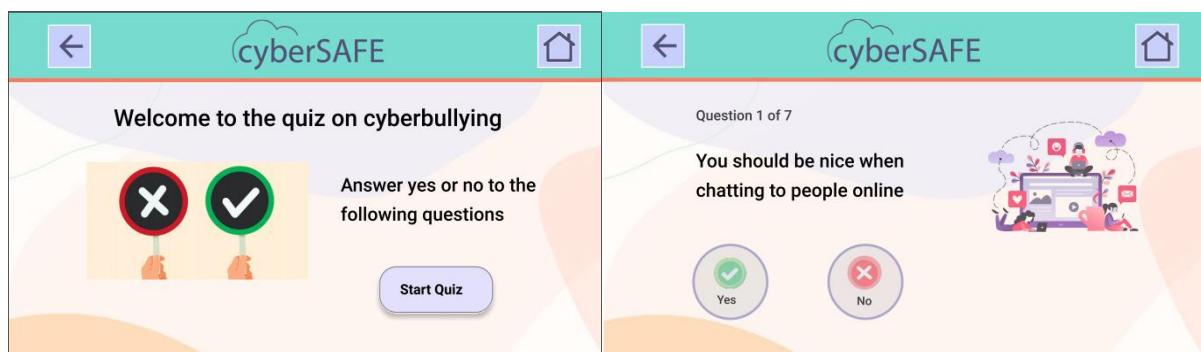
Tick the box.



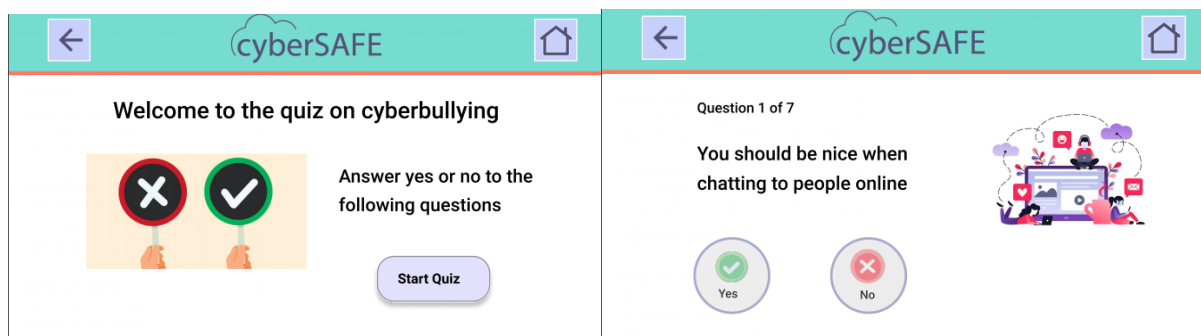
2. Which quiz background do you prefer?

Tick the box.

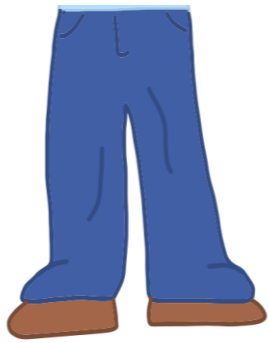
With colour



Without colour



3. This character has half a body. Finish drawing this character.



Appendix F: Pre- Codesign workshop 2: planning questions

Co-Design Workshop 2 Planning Questions.

Co-design planning tool in Miro board poses questions and here are answers the researcher thought about and considered concerning the optimal codesign session conditions.

What frameworks are needed for safety for all involved?

The Co design session will be organised abiding by the ethical and safety framework within SJOG, DCU and IADT.

How do people in the context want to engage to learn?

A visual and kinesthetic approach will be used so the learning is in that context

Where are the gaps worth filling?

Codesign methods frequently draw upon exactly those skills that people living with cognitive or sensory impairments have problems with.

Higher order cognitive skills are often required, such as abstraction, conceptualization or creative thinking. Through simplified task design (tactile engagement with options) the problem with abstraction/conceptualisation may be solved.

What is already happening in the context? Where is their strength?

The session will focus on a participatory approach. The aim is to facilitate moving people from participants to active design partners.

What relationships do we need to focus on?

We need to design the tasks in a way that co designers' needs and abilities are taken into consideration. The tasks need to be finely tuned to then draw conclusions by analysing the session's positives and negatives.

How will we widen inclusion?



Designing with people is about what matters to people with lived experience and decision-makers (co-decided).



What are the gives and gets for co-designers?

The co-designers require support and encouragement to adopt new ways of being and doing, learn from others, and have their voices heard. To support that, the facilitator needs to coach. Everyone has something to teach and something to learn.




Appendix G: Lab 1 Usability Task list

Usability Task list for Lab 1

Task	Task Description
1 Click Cybersafety,	Watch 1 video on cyberbullying tips 
Click on cyberbullying,	 Cyberbullying
Click on tips	

	
<p>Press play on video</p>	

Task	Task Description
2	Task 2 Play the Maze game
Click Trust	


	 <p>Trust</p>
Click who	 <p>Who</p>
Click Maze game	 <p>Maze Game</p>

Accept or reject friends to get through the maze



Task	Task Description
------	------------------

3	Take the Quiz
---	---------------

Click Cybersafety	 <p>CyberSafety</p>
-------------------	--



Click cyberbullying	 <p>Cyberbullying</p>
---------------------	---



Take the quiz



Click Start button



Answer Yes or NO



Appendix H: Post lab 1 accessible usability questionnaire



ADAPTED SYSTEM USABILITY SCALE



What did you like?

.



What did you not like?

.



Was it easy to use?

PLEASE TICK



Which was your favourite way to learn?



Read



Listen



Watch



What were your favourite parts of CyberSafe?

.



What parts of CyberSafe did you not like?

.



Understand

Was everything easy to understand?

.



Did you find anything hard to understand?

Appendix I: Lab 2 Accessible SUS questionnaire created with smileometers

Adapted SUS

Please Circle



Was the video about cyberstalking easy to understand?

Very easy



Easy



Hard



Very hard





How easy was it to play the Coin game?

Very easy



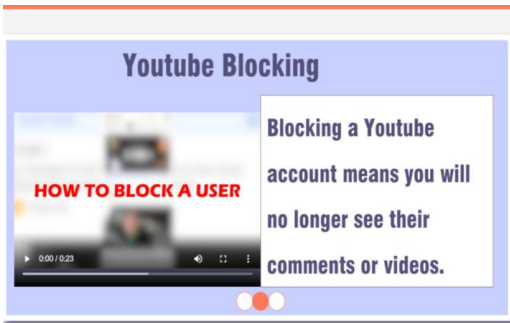
Easy



Hard



Very hard



Was the video about blocking on Youtube easy to understand?

Very easy



Easy



Hard



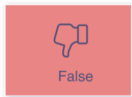
Very hard



Cyberstalking



Q1. Cyberstalkers can find your location from pictures



Was the quiz about cyberstalking easy to understand?

Very easy



Easy



Hard



Very hard





Did you like the Coin game?

Like a lot



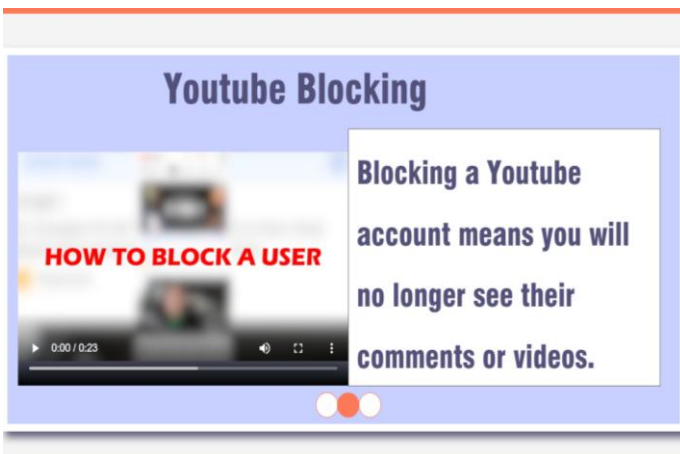
Like a little



Dislike a little



Dislike a lot



Did you like watching video on Blocking in YouTube?

Like a lot



Like a little



Dislike a little



Dislike a lot





Did you like the cyberstalking video?

Like a lot



Like a little



Dislike a little



Dislike a lot



Do you like how CyberSafe looks?

Like a lot



Like a little



Dislike a little



Dislike a lot



Cyberstalking



Q1. Cyberstalkers can find your location from pictures

True False

Did you like the cyberstalking Quiz?

Like a lot



Like a little



Dislike a little



Dislike a lot



CyberSafety Trust Personal Info
Respect Safety Privacy

Did you like the colours used in CyberSafe?

Like a lot



Like a little



Dislike a little



Dislike a lot



Did you like the pictures in CyberSafe?

Like a lot



Like a little



Dislike a little



Dislike a lot



What do you want more of in CyberSafe? Please ✓



Games

Support

Support?



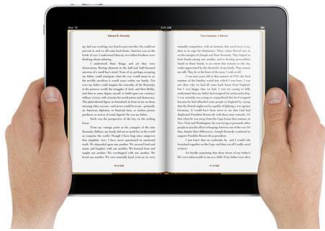
Always tell someone you trust:

- A family member.
- A teacher.
- A close friend.

Videos with animation



Videos with people



Reading



Something else?






What did you not like?

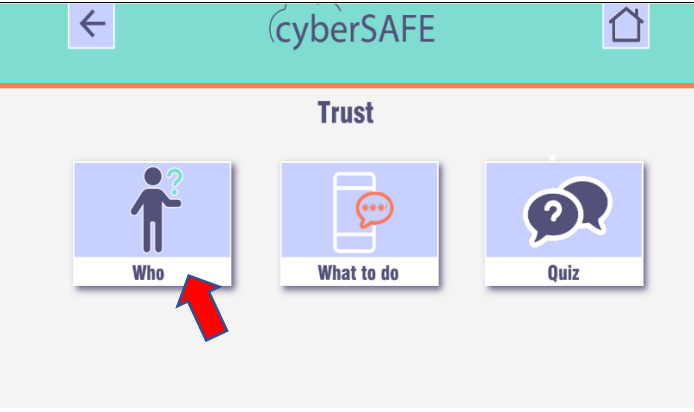
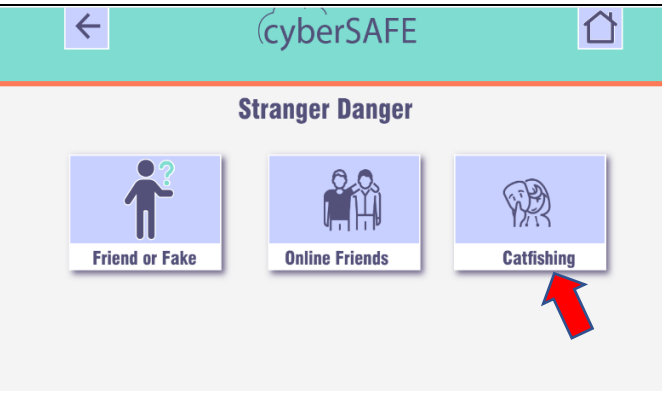
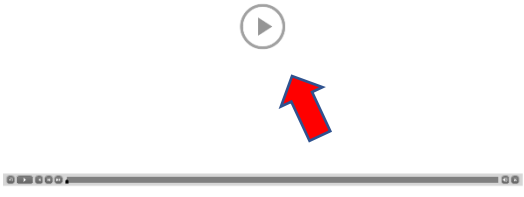



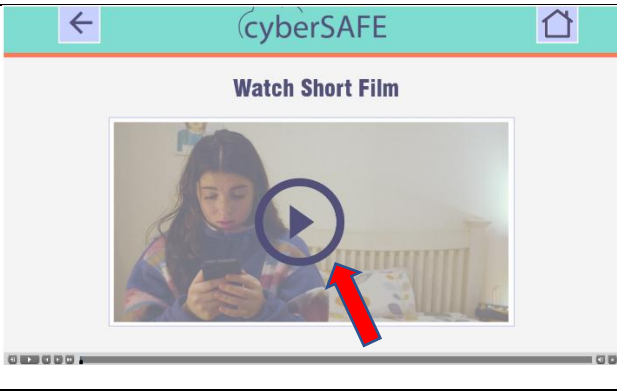
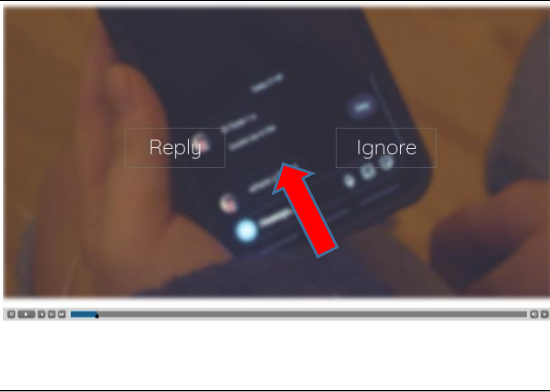
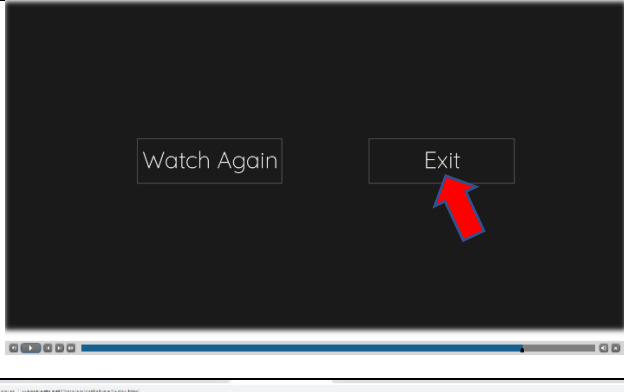
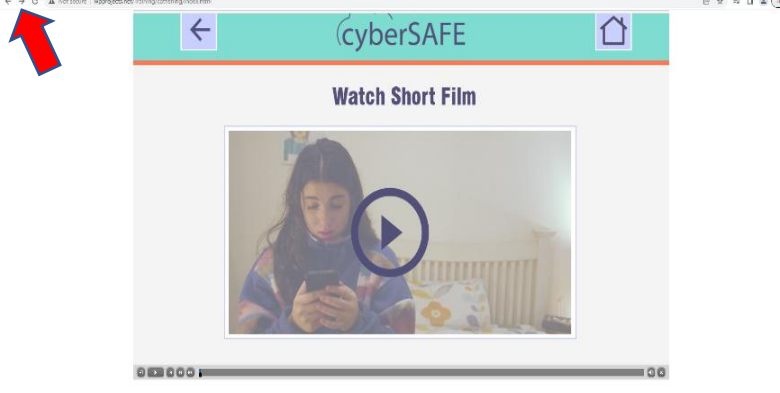
What were your
favourite parts?

Appendix J: Lab 3 ask List and Accessible SUS questionnaire created with smileometers

TASK LIST Lab Activity

Task	Task Description
<p>Little Tip:</p> <p>When the hand  appears you can click.</p> <p>When the arrow  appears you can't click.</p>	
<p>Task 1</p>	<p>Learn all about stranger danger and Catfishing</p>
	<p>Click on Trust</p>

	<p>Click on Who</p>
	<p>Click Catfishing</p>
	<p>Click on Play button</p>
	<p>Click on ? Catfishing</p>

	<p>Click on Play button to play the video and learn about Catfishing</p>
	<p>Click on the interactive buttons when they appear For example, “Reply” or “Ignore” buttons</p>
	<p>Click on Exit to exit the video</p>
	<p>Click on left arrow to exit the video</p>
<p>Task</p>	<p>Task Description</p>

Task 2

Play Friend or Fake game to learn how to differentiate between real celebrities and imposters



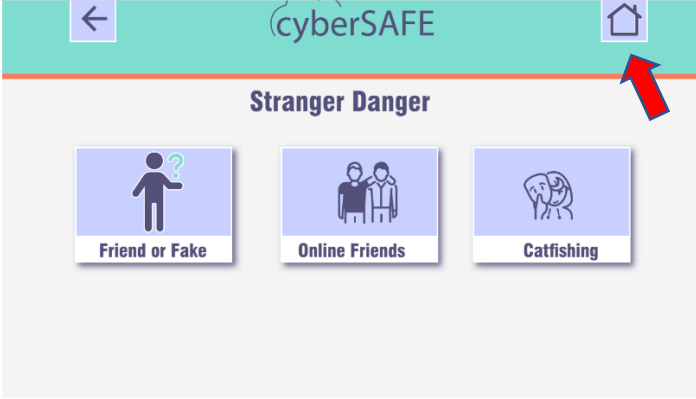

Click on **Friend or Fake**



Click on **Start** to play the game

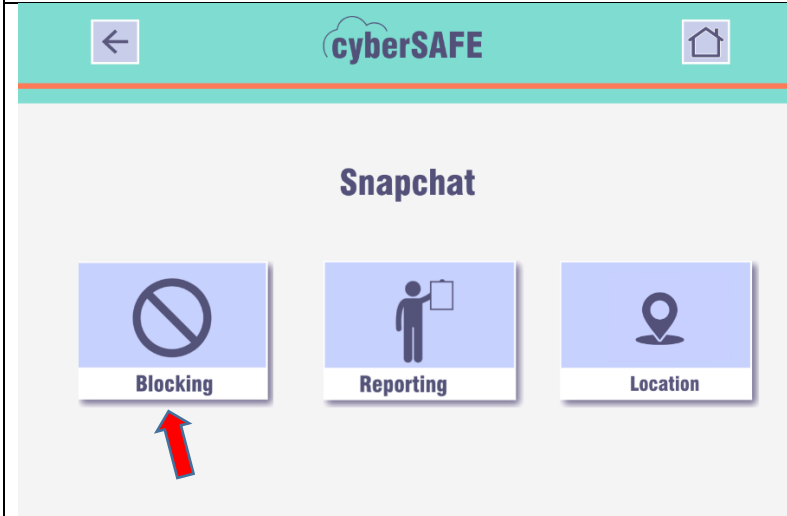


Click **Home** when done

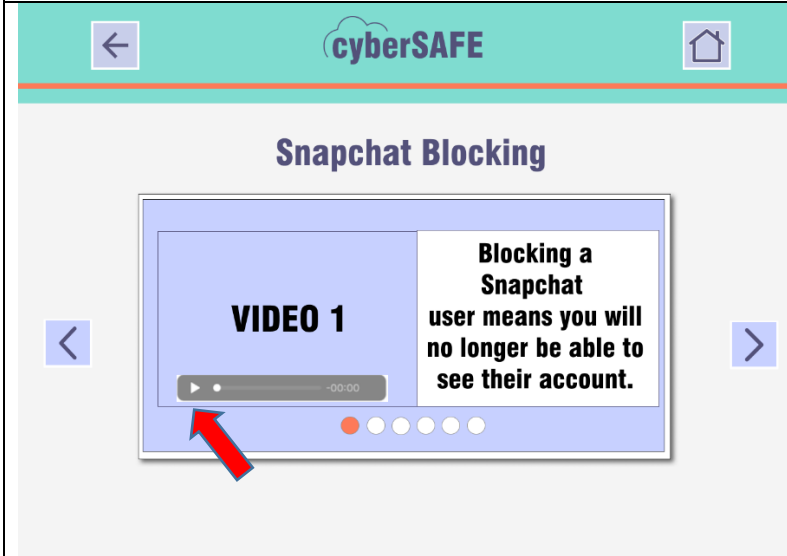
Task	Task Description
<p style="text-align: center;">Task 3</p>	<p>Learn how to block someone on Snapchat</p>
	<p>Click on Home icon</p>
	<p>Click on Privacy Settings</p>




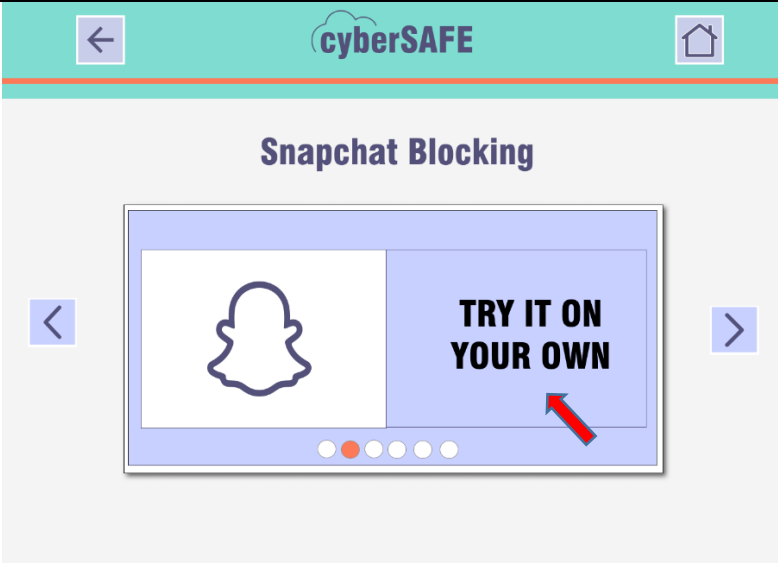
Click on **Snaphchat**



Click on **Blocking**

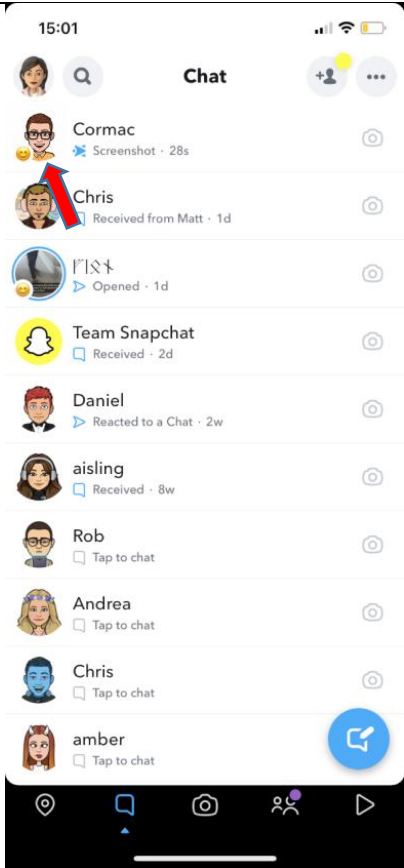


Click on **Play video button**

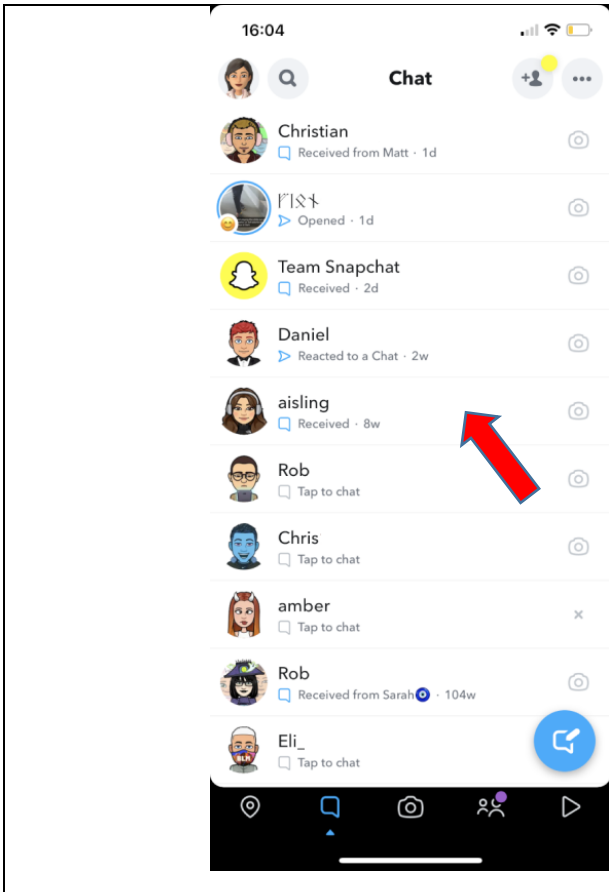
 <p>The screenshot shows a mobile application interface with a teal header containing a back arrow, the 'cyberSAFE' logo, and a home icon. Below the header, the title 'Snapchat Blocking' is centered. The main content area features a video player labeled 'VIDEO 1' on the left and a text box on the right that reads: 'Blocking a Snapchat user means you will no longer be able to see their account.' Navigation arrows are present on the left and right sides of the video player, and a red arrow points to the right navigation arrow.</p>	<p>After video is done, click on the arrow to go to the next Blocking screen</p>
 <p>The screenshot shows the same mobile application interface. The video player now displays the Snapchat logo on the left and the text 'TRY IT ON YOUR OWN' on the right. A red arrow points to the text 'TRY IT ON YOUR OWN'.</p>	<p>Click on the "Try it on your own" to try to block somebody</p>



Click on **the Snapchat icon**



Click on the **user name "Cormac" icon photo** to start



After the game is done click **anywhere on the main Snapchat Screen**

Task 4

Learn how to **report** someone on Snapchat



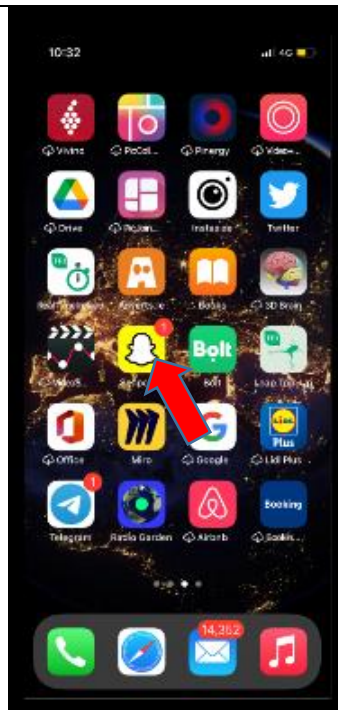
Click on **Play video button**



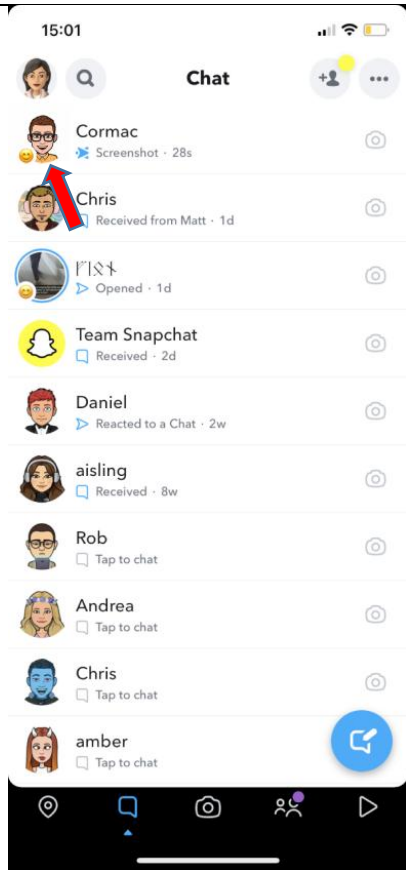
After video is done, click on **the arrow** to go to the next Reporting screen



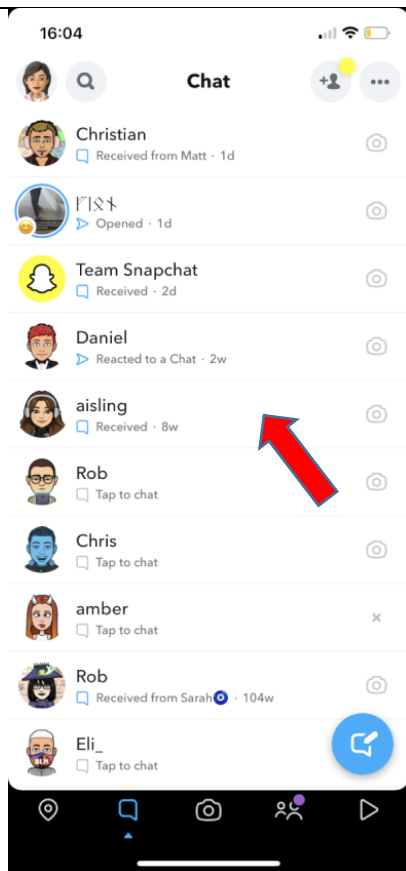
Click on the **“Try it on your own”** to try to Report somebody



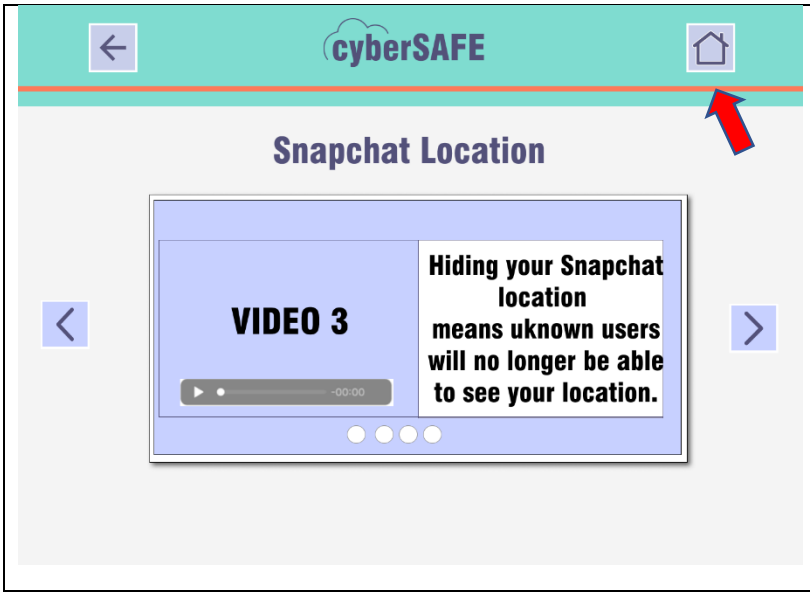
Click on **the Snapchat icon**



Click on the **user's name "Cormac" icon photo** to start


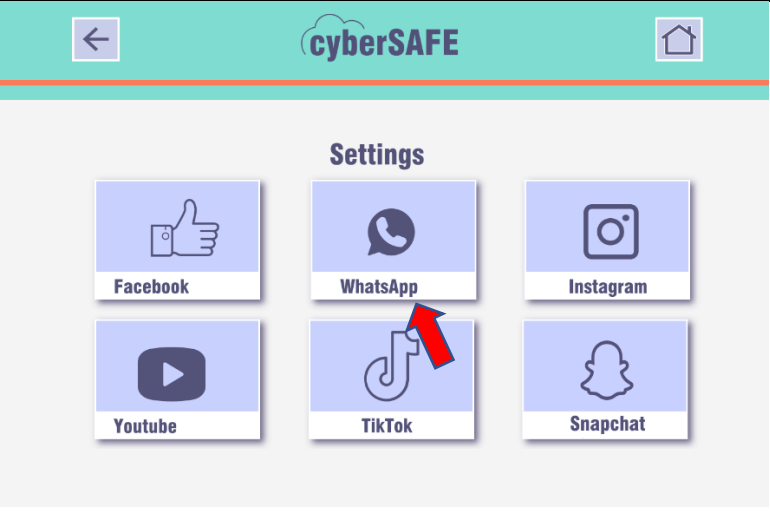





After the game is done, click **anywhere on the main Snapchat Screen**



The screenshot shows a mobile application interface. At the top, there is a teal header bar with a back arrow on the left, the "cyberSAFE" logo in the center, and a home icon on the right. A red arrow points to the home icon. Below the header, the text "Snapchat Location" is displayed. The main content area features a video player titled "VIDEO 3" with a play button and a progress bar. To the right of the video player, a text box contains the message: "Hiding your Snapchat location means unknown users will no longer be able to see your location." Navigation arrows are visible on the left and right sides of the video player, and a series of four dots at the bottom indicates the current slide position.





Click on **Home icon**

Task	Task Description
<p style="text-align: center;">Task 3</p>	<p>Learn how to use WhatsApp safely</p>
	<p>Click on Privacy Settings</p>
	<p>Click on WhatsApp</p>

	<p>Click on play video button</p>
	<p>After video is done, click on the arrow to go to the next video Please watch all of the 6 videos</p>
	<p>When the last video is done click the Home button</p>

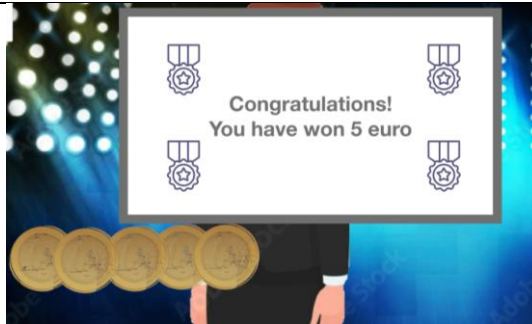
Now click on second tab at the top of the screen to play a game.



Task	Task Description
5	Task 4 Play the Coin game
Click Trust	
Click Who	
Click Coin Game Quiz	
Listen and click on correct answer to win a coin	

You have win 5 euros!

Click the congratulations box.



Adapted SUS

Please Circle



Was the video about Catfishing easy to understand?

Very easy



Easy



Hard



Very hard





How easy was it to play the Coin game?

Very easy



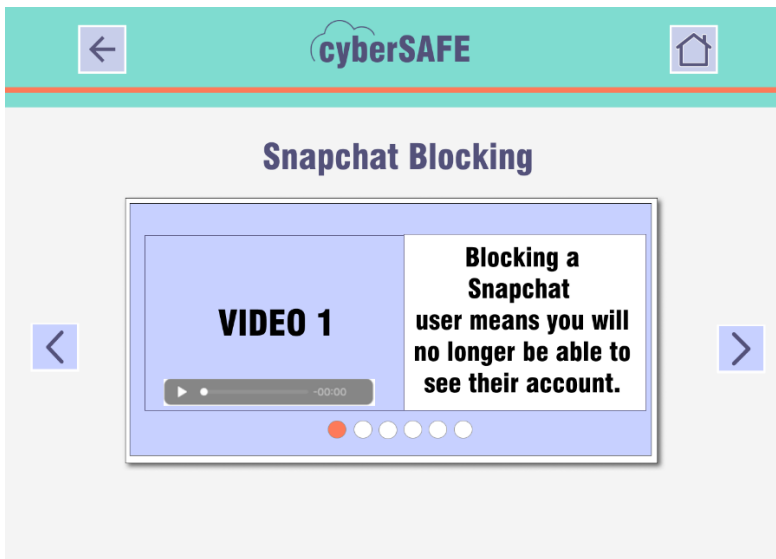
Easy



Hard



Very hard



Was the video about blocking on Snapchat easy to understand?

Very easy



Easy



Hard



Very hard





Was the Friend or fake game easy to understand?

Very easy



Easy



Hard



Very hard





Did you like the Coin game?

Like a lot



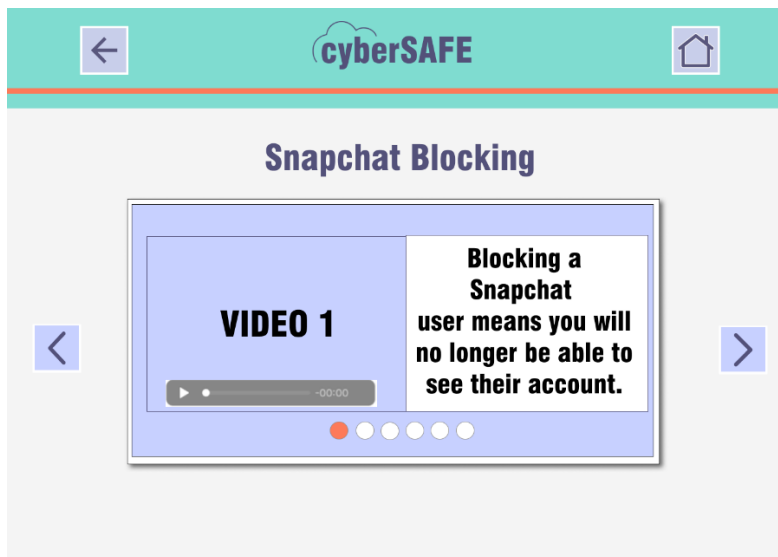
Like a little



Dislike a little



Dislike a lot



Did you like watching video on Blocking in Snapchat?

Like a lot



Like a little



Dislike a little



Dislike a lot





Did you like the catfishing video?

Like a lot



Like a little



Dislike a little



Dislike a lot



Do you like how CyberSafe looks?

Like a lot



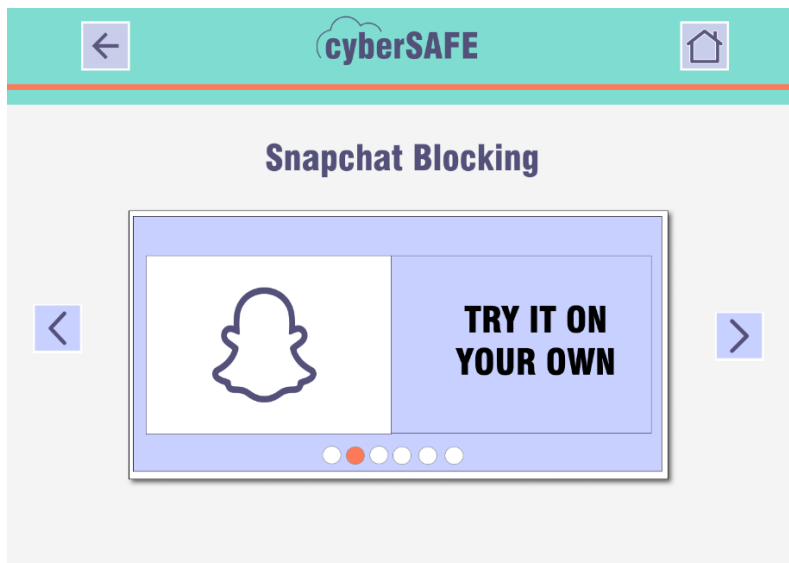
Like a little



Dislike a little



Dislike a lot



Did you like the “Try it on your own” Snapchat game?

Like a lot



Like a little



Dislike a little



Dislike a lot





Did you like the colours used in CyberSafe?

Like a lot



Like a little



Dislike a little



Dislike a lot



Did you like the pictures in CyberSafe?

Like a lot



Like a little



Dislike a little



Dislike a lot



What do you want more of in Cybersafe? Please



Games

Support

Support?



Always tell someone you trust:

- A family member.
- A teacher.
- A close friend.

0:12 / 2:20

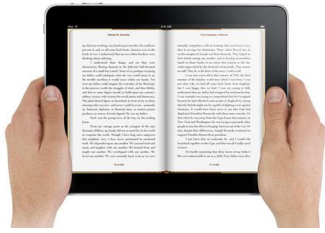
YouTube

Videos with animation



Videos with people





Reading



Something else?



What did you not like?



What were your favourite parts?

Appendix K: Sample from Quote diary from Empathy workshops

24) Number 5: "Sky sports, I play Liverpool."

25) Number 1: "I am a huge fan of Liverpool as well. I watch it with my Dad."

26) Care worker 2: "Number 1, do you use the sports app as well?"

Number 1: "No, my Dad does."

27) Researcher: "Morning, noon and night! So, number 3 is texting staff, is she typing or leaving voice

messages?"

Care worker 1: "She uses voice messages".

28) Care worker 2: "Or links to favourite songs?"

29) Number 5: "I call my Mom sometimes, or my girlfriend."

30) Researcher: "Do you send links to your favourite songs? Or Photographs?"

Number 5: "I think James bond."

31) Number 5: "One day it was James Bond, another day it was MS. Marvel and Number 5 couldn't stop."

32) Number 5: "Well I do these group chats with (Name redacted) just to have those chats, just to keep it going, just to keep the friendship going."

33) Researcher: "Would you know the difference, would you know they were a stranger?"

Number 2: "I'd just hang up on them."

34) Number 1: "When the phone rings, mum would always get these dodgy numbers online that try to take your money off you. Mum and dad always get them on their phones and mum and dad would have to just hang up."

35) Number 5: "There was a few numbers I didn't know and I was checking with my carer and we managed to take them off my phone." "I struggled that time and I was like I'm going to go to (Carers name) and just get this problem sorted out".

36) Care worker 2: "People add numbers only to realise they don't know them. Then suddenly they are part of the group and then there will be contact."

Researcher: "Is this on whatsapp?"

Care worker 2: "Yes its an issue."

37) Researcher: "Would the rest of the group accept a friendship request? Or wants to be your friend or wants to join you on WhatsApp, would you accept them as a friend?"
Number 1: "I don't."
Researcher: "You don't, ok."
Number 5: "I would say no."
Researcher: "No, even if they pretending to be Justin Timberlake or they pretended to be Niall Horan".
Care worker 1: "Yeah or Zack Effron?"
Everyone in unison: "Yeahhh!"
Number 1: "That's who my Cybercrush is!"

38) Care worker 1: "If Zack effron sent you a friend request would you accept it?"
Number 3: "No."
Researcher: "No, why number 3?"
Number 3: "I don't know."
Care worker 1: "Yes you do, think about it."
Number 1: "Yes, obviously."
Researcher: "Why is it obviously, what is obvious number 1? When you say obviously you wouldn't accept it? Why?"
Number 1: "Ehm.. Sorry, I just can't."

39) Number 5: (In relation to celebrity friends' requests) "This is going too far".

40) Care worker 2: "If Zack sent you a text message would you answer it?"
Number 6: "Yes."
Group in unison: "(Name of number 6)!!"
Care worker 1: "So (Name of number 6) (Name of number 6) would you know? Have you ever met Zach Effron?"
Number 6: "I haven't."
Number 1: "I haven't either."
Care worker 1: "In real life, have you ever met Zack?"
Number 1: "I haven't either."
Care worker 1: "No? So that's why you have to think."
Number 5: "This is going too far."

Appendix L: List of Videos

List of videos in <i>CyberSafe</i>	Source
<i>What is Cyberbullying?</i>	Sourced from Reach Out.com
<i>Online scams:</i> sourced from YouTube	https://www.youtube.com/watch?v=4yejYwcaITA&t=10s
<i>Prevent online Scams</i>	https://www.youtube.com/watch?v=R12_y2BhKbE&t=4s
<i>Respect:</i> sourced from YouTube	https://www.youtube.com/watch?v=GOzrAK4gOSo&t=2s
<i>Empathy:</i> sourced from YouTube	https://www.youtube.com/watch?v=9_1Rt1R4xbM
<i>Peer Pressure:</i> sourced from YouTube	https://www.youtube.com/watch?v=tScDrhxf53k&t=8s
<i>Personal information:</i>	Sourced form Safe Surfing EU project
Some videos made by IADT students	<ul style="list-style-type: none"> • <i>CyberStalking</i> • <i>FaceBook Privacy settings</i> • <i>YouTube Blocking and reporting</i> • <i>Snapchat Blocking and reporting</i> • <i>TikTok Blocking and reporting</i> • <i>Online friends</i>
<i>Interactive catfishing</i> video	Created by graduate Cormac Lalor

Appendix M: Ethical Approval letters

Ollscoil Chathair Bhaile Átha Cliath
Dublin City University



Dr. Miriam Judge
School of Communications

Marian McDonnell
School of Communications

17th February 2022

REC Reference: DCUREC/2022/005

Proposal Title: **Cybersafe:User Experience Design of a cybersafety educational application for young adults with mild Intellectual Disability**

Applicant(s): **Dr. Miriam Judge and Marian McDonnell**

Dear Colleagues,

Thank you for your application to DCU Research Ethics Committee (REC). Further to full committee review, DCU REC are pleased to issue approval for this research proposal.

DCU REC's consideration of all ethics applications are dependent upon the information supplied by the researcher. This information is expected to be truthful and accurate. Researchers are responsible for ensuring that their research is carried out in accordance with the information provided in their ethics application.

Materials used to recruit participants should note that ethical approval for this project has been obtained from the Dublin City University Research Ethics Committee. As part of DCU REC's ongoing monitoring process, during your research you may be asked to provide DCU REC with a progress report. Should substantial modifications to the research protocol be required at a later stage, a further amendment submission should be made to the REC.

Yours sincerely,

A handwritten signature in black ink, appearing to read 'Dr. Melrona Kirrane'.

Dr. Melrona Kirrane
Chairperson
DCU Research Ethics Committee



Taighde & Nuálaíocht Tacaíocht
Ollscoil Chathair Bhaile Átha Cliath,
Baile Átha Cliath, Éire

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F +353 1 700 8002
E research@dcu.ie
www.dcu.ie



Saint John of God Hospitaller Services Group

Marian McDonnell
Lecturer in Computing
IADT
Department of Technology and Psychology, IADT, Kill Avenue, Dun Laoghaire

10th May 2022.

E-mail: marian.mcdonnell@iadt.ie

ID805 Cybersafe: User Experience Design of a cybersafety educational application for young adults with mild Intellectual Disability.

Dear Marian,

The Committee has considered and approved your application. You now have the permission of the Research Ethics Committee to proceed with the aspect of your research that seeks to use Saint John of God Hospitaller Services Group, as a potential source of participants for your study.

This permission is valid for the period of 12 months from the date of this letter. If further time is required to gather data, you must reapply to the Committee to have the decision reviewed setting out clearly the reasons for the extension. We cannot guarantee that such extensions will be granted. Ethical approval is granted on the condition that you ensure that you are in compliance with the GDPR regulations which were introduced on May 25, 2018, the Data Protection Act which was transposed into law on May 24th 2018 and subsequently, the Health Research Regulations on August 2018. We encourage you to review the information available on the Health Research Board website: <http://www.hrb.ie/funding/gdpr-guidance-for-researchers/> and the Dept. of Health website <https://health.gov.ie>. Please note that it is your responsibility as a researcher to ensure that your research is compliant with this new legislation.

Furthermore, the Committee reminds you that you have agreed to the following, as indicated on the Applicant's Checklist:

- To fully acknowledge the role of Saint John of God Hospitaller Services Group, in facilitating this research in any written papers, posters and/or conference presentations.
- Any publication of the findings will a) include Saint John of God Hospitaller Services Group as a contributor and b) incorporate the logo where possible (a jpeg file will be provided upon request)
- To forward a copy of your findings and/or any publications/research posters to Saint John of God Hospitaller Services Group Library upon completion, to be made available to all staff.
- To permit your findings and/or any publications to be made available to the general public on the www.sjog.ie website upon completion, as deemed appropriate
- Upon completion you will be expected to present at the annual Saint John of God Hospitaller Services Group Research Study Day, as agreed with the Research Department.

Meanwhile, may I take this opportunity to wish you well in your research. We look forward to hearing of your progress over the coming months.

Yours sincerely,

Professor Mary Clarke (Acting Chair)
Saint John of God Hospitaller Services Group

Hospitaller House, Stillorgan, Co. Dublin, A94 X5K8, Ireland. Tel: +353 1 533 3300 www.sjog.ie
Saint John of God Hospitaller Services Group clg is a company limited by guarantee.
Directors: Mary Collins, Bill Cunningham, William Forkan, John Gallagher, Anne Gunning, Anthony Hanna,
John Lennon, Robert Moore, Mary Philomena O'Donovan. Registered office: Granada, Stillorgan, Co. Dublin, A94 D9N1.
Reg. Company No. 568740 Reg. Charity No. CHY 21436 CRA No. 20106515

Hospitality Respect Justice Compassion Excellence

Appendix N: Macedo and Trevisan (2013) evaluation method measuring usability and interaction

Usability Observation Sheet

Description	Code	Frequency Count	Context	Commentary & Free-Form Notes
No Errors	ERR +			
Error/Wrong Action	ERR -			
No help needed	HLP +			
Needs help	HLP -			
Tasks are clear	CON +			
Confused, unsure how to proceed	CON -			
No physical/motor problems	MOT +			
Physical/motor problems	MOT -			
Clearly see & hear audio	PER +			
Perception – sight / hearing problem	PER -			

Engagement Observation Sheet

Description	Code	Frequency Count	Context	Commentary & Free-Form Notes
Task completed	STP +			
Stop before reaching goal	STP -			
Interested, focused	INT +			
Bored- sighing, looking around, passive	INT -			
User likes something specific	LIK +			
User dislikes something specific, behaviour	LIK -			

Appendix O: Screen shots from the Coin game



Appendix P: Google Drive links

Chapter 3

Thematic coding maps and raw data samples

https://drive.google.com/drive/folders/1r0jgojHbMA45U8ynMZ-h4dL7odnM1rP1?usp=drive_link

Coding frame from the adapted Devan method.

https://docs.google.com/document/d/1plirvINkgMQuinXT_TlHe5itQdAP1NQU/edit?usp=sharing&oid=101782315120989203271&rtpof=true&sd=true

Macedo and Trevisan (2013) coding frame to measure usability and interaction of children with Down 's syndrome which informed Cybersafe's observation data analysis and data coding.

Chapter 4

Questions for 4 stakeholder interviews

https://docs.google.com/document/d/1b-5lqx3i0XoIXJeyj8QM9xNM_GFx7YyB/edit?usp=sharing&oid=101782315120989203271&rtpof=true&sd=true

Stakeholder interview protocol

https://docs.google.com/document/d/1b-5lqx3i0XoIXJeyj8QM9xNM_GFx7YyB/edit?usp=drive_link&oid=101782315120989203271&rtpof=true&sd=true

14 support workers survey

<https://forms.office.com/e/UCBnLrFqtC>

Empathy workshop semi-structured interview schedule (SSIS) with 11 open-ended questions for PWID

<https://docs.google.com/document/d/1OXEgKouTf9M2yVHPzRbHdj0UsYtFUXZB/edit?usp=sharing&oid=101782315120989203271&rtpof=true&sd=true>

Codesign workshop materials

[https://drive.google.com/drive/folders/1-vHlzANyZ0_HMKt7k1WItk259TbliSnR?usp=drive link](https://drive.google.com/drive/folders/1-vHlzANyZ0_HMKt7k1WItk259TbliSnR?usp=drive_link)

Codesign workshop planning questions

https://docs.google.com/document/d/19mBc7QfpCDFUmA_QfxN9MxzXsBF200N2/edit?usp=sharing&oid=101782315120989203271&rtpof=true&sd=true

Task list and post lab accessible adapted system usability scale(SUS) questionnaire Lab 1

<https://docs.google.com/document/d/1L7vYxsYAbQIS5IVYXlq9Q0qPvs7EuSiX/edit?usp=sharing&oid=101782315120989203271&rtpof=true&sd=true>

Post lab accessible adapted system usability scale(SUS) questionnaire Lab 2

https://drive.google.com/drive/folders/1brs5vUUfgYAwRQUh378GogZLoTGYXs_J?usp=sharing

Task sheet and Post lab accessible adapted system usability scale (SUS) questionnaire Lab 3

https://docs.google.com/document/d/17YX04_4RBKwWILbdQ_TGOcPAzEjKP1mS/edit?usp=drive_link&oid=101782315120989203271&rtpof=true&sd=true

Chapter 6 results

Themes, subthemes, codes and frequency tables for expert interviews.

https://docs.google.com/document/d/1D7-Ob6hgkshpolPktmoAJh6bSnHzUvux/edit?usp=drive_link&oid=101782315120989203271&rtpof=true&sd=true

Researcher observational data analysis and data coding (codes and descriptions) for Lab 1

<https://drive.google.com/drive/folders/1-h-EzucaCNe6owCCSrZzv8nqEKuqxM5j?usp=sharing>

Empathy workshop 1 coded data

<https://drive.google.com/drive/folders/1LzeVrSPziYAcXYnVklIWbsISurWDFNYr?usp=sharing>

Recorded data files from Empathy workshop 1

https://drive.google.com/drive/folders/18e9LOWkocHzQeB1u1bjDE5W00C_5z5X6?usp=sharing

Co-Design workshop 1

<https://drive.google.com/drive/folders/16FUbmikE8LBnG9S0WZVqtNZYAAFRvSn6?usp=sharing>

Lab 1 Camtasia recordings and Researcher observations coding

<https://drive.google.com/drive/folders/1BJlpz9UEbLDDRUXFCvzSqQuju-eyXR6e?usp=sharing>

Lab 2 Camtasia recordings and Researcher observations coding

<https://drive.google.com/drive/folders/14xoFHsCNilpX3bQoR9O2pepatmeCuFnu?usp=sharing>

Lab 3 Camtasia recordings and Researcher observations coding

https://drive.google.com/drive/folders/1uVc7IWqViEYmL6CehYiAju5XD3_oocl?usp=sharing

Ethical approval letters

St John of God

https://drive.google.com/file/d/1tNPLGvgbHxQJGt9TaCzOBoPi3Rhb0qRa/view?usp=drive_link

From Dublin City University

https://drive.google.com/file/d/1tGWWtRt-yzWOUCeTaG3ITvLbcKjv-fZ7/view?usp=drive_link

Appendix Q

Codes			
Navigation issues			
Errors			
Suggestions			
Learnability			
Likes			
Knowledge			
Preferences			
Preferences			
Clarification			
Focus attention			
Reading and Writing			
Elaboration			
Reassurance			
Safeguarding			
CarerComment			
Fun			
Vulnerability			
Prefered Platform???			
Separation			
Totals			
Themes	Sub Themes	Codes	
Design	Negative Usability	Errors Navigation issues	
	Positive Usability	Likes Learnabilty	
	Changes to apply	Suggestions	
Positive engagement	Enjoyment	Fun Preferences	
Carer opinions	Carer mediation	Carer comment	
Stranger Danger	Safeguarding Vulnerability		
Separating Spaces	Knowledge Lack of Knowledge Separation		
Reassurance & Praise	Help	Clarification Focus attention Elaboration Reading and Writing	
	Reassurance		