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Digital technology design activities—A means for promoting the digital inclusion of young adults with intellectual disabilities

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Abstract

Background: Information and communication technology has become an important aspect of everyday life, including community living and social participation. However, people with intellectual disabilities face several societal inequalities, including digital exclusion. Even if people with intellectual disabilities still do not have the same access as others, this group is increasingly involved in digital technology design activities. Although digital technology design activities can lead to several user gains, little is known about how such activities affect digital inclusion. Therefore, we explore whether and how participation in digital technology design activities can support the digital inclusion of young adults with intellectual disabilities.

Methods: We interviewed seven young adults with intellectual disabilities about their participation in ten digital technology design sessions. We also collected reflective notes from eight support workers who participated in the same design activities. The interviews were analysed thematically.

Findings: Thematic analysis generated four themes describing how participation in technology design activities can support the digital inclusion of people with intellectual disabilities: improving digital skills and knowledge, displaying skills and competence, increased interest in technology use, and influencing and adapting technology.

Conclusions: Participation in digital technology design activities with support workers can provide new opportunities for young adults with intellectual disabilities and can help overcome several digital activity barriers. Designers and researchers should increasingly, and actively involve people with intellectual disability in digital technology design activities as it can support and promote digital inclusion.

KEYWORDS
intellectual disability, learning (intellectual) disabilities, research

Accessible summary

- We talked to young adults with intellectual disabilities about taking part in design activities.

- The people we talked to said that they learned more about technology, how to use it and became more interested in using it.
- The results show that taking part in technology design activities supports the digital inclusion of people with intellectual disabilities.
- When designing technology, it is important to involve people with intellectual disabilities.

1 | INTRODUCTION

Information and communication technology (ICT) has become an important aspect of community living and social participation (Chadwick et al., 2013). Lately, due to the COVID-19 pandemic, there has been a rapid transfer of everyday activities to the digital world, and ICTs have become even more embedded in people's lives (Chadwick et al., 2022). Today, technology is intertwined with nearly all areas of everyday life (Chadwick et al., 2022; Larsson-Lund & Nyman, 2019), and services are now offered in digital environments, sometimes with no offline alternatives (Borg & Smith, 2018). With the world becoming increasingly digital, access to usable technology is not a question of convenience but of necessity (Wehmeyer et al., 2020).

Digital inclusion refers to the ability of individuals and groups to access and use ICT. According to Tsatsou (2011, 2020), digital inclusion is multifaceted and includes 'a complex terrain of hurdles', and many people are underserved, disadvantaged and underrepresented in technology access, knowledge and use (Jaeger et al., 2011, 2012). The increased digitisation in society implies that the social and the digital merge and increases the concern about who is left behind. Hence, digital inclusion refers not only to the ability of individuals and groups to access and use ICT but also the ability to participate fully in the social world (Bailey et al., 2020). Unequal personal access to ICT and online information has produced the so-called *digital divide*. The digital divide implies a gap, based on several factors (e.g., socioeconomic status, education, age, ability), between those with internet and ICT access and those without (Jaeger et al., 2012).

People with intellectual disabilities are especially at risk of being digitally excluded (Chadwick et al., 2013). Intellectual disability is characterised by significant limitations in both intellectual functioning and adaptive behaviour, including several social and practical skills (Schalock et al., 2021). Originating during the developmental period, intellectual disability includes several subcategories or subgroups which include mild, moderate, severe and profound intellectual disability. However, while there is a growing body of research targeting disability as a factor in the digital divide, disability as a reason for digital inclusion is not as recognised as other background variables such as age, gender and socioeconomic factors. Although Article 9 of the Convention on the Rights of Persons with Disabilities (CRPD) highlights the importance of equal access to ICTs, a Swedish study showed that people with intellectual disabilities use ICT less frequently than the rest of the population (Ramsten et al., 2020).

Digital exclusion is a problem because ICT can provide opportunities for people with disabilities to participate in the community (Chadwick et al., 2019; Manzoor & Vimarlund, 2017). The benefits of ICT use for people with intellectual disabilities include improved self-esteem and well-being, self-determination, social relationships, and education (Chadwick et al., 2013, 2019). For instance, technology can provide access to social networking sites (Holmes & O'Loughlin, 2014), facilitate transportation (Davies et al., 2010) and foster participation in other activities (Parsons et al., 2006). Technology can also support domains such as school, work and community inclusion (Wehmeyer et al., 2020). However, compared to the general population, people with intellectual disabilities have fewer opportunities for participation through ICT use (Chadwick et al., 2013). Although research has shown an increase in the use of the internet and ICT devices by people with intellectual disabilities (Chiner et al., 2017), a digital divide still exists (Alfredsson Ågren et al., 2020). People with intellectual disabilities experience exclusion from digital spaces (Chadwick et al., 2013) and the focus of their ICT use is often related to leisure time including playing games and engaging in social interaction (Alfredsson Ågren et al., 2020).

According to Chadwick et al. (2019), barriers to digital inclusion for people with intellectual disabilities include literacy and communication skills, ICT skills, cyber etiquette and cyber language. Other digital inclusion barriers include limited support from carers and local community services and a lack of finances for technology. The lack of accessible and adapted technology and websites, as well as the lack of involvement of people with intellectual disabilities in ICT design, increases the digital exclusion of people with intellectual disabilities. Furthermore, people with intellectual disabilities tend to face barriers related to cultural norms, such as societal exclusion, offensive social attitudes and negative social expectations (Chadwick et al., 2019). To support the inclusion of people with intellectual disabilities in the digital world, government initiatives, digital education, creativity and problem-solving are essential (Chadwick et al., 2022). In addition, designers and researchers are encouraged to involve people with intellectual disabilities in the design of technology (Benton & Johnson, 2015; Safari et al., 2021). In this article, digital technology refers to digital solutions such as internet software and applications. Moreover, technology design,

a term used in earlier literature (Benton & Johnson, 2015), is the process of designing and developing such products, systems or services.

In recent years, adapted technological solutions have been developed, and people with intellectual disabilities have become involved in the design of technological solutions, such as transport support tools (Wass et al., 2020), a mobile application (Wilson et al., 2016), a web application (Bayor et al., 2021) and a learning tool (Raman & French, 2021). Although the involvement of people with intellectual disabilities in technology design activities can promote digital inclusion through adapted technology (Lussier-Desrochers et al., 2017), little is known about how participation in such activities in itself can affect digital inclusion. Therefore, in this study, we explore this potential by focusing on a project that involved young adults with intellectual disabilities in the design of a digital self-reflective tool.

Our research seeks to answer the following research question: How can participation in digital technology design activities support the digital inclusion of people with intellectual disabilities?

1.1 | Digital inclusion models

The digital divide that exists for people with intellectual disabilities cannot be explained by disability or impairment alone. Instead, numerous individual, environmental and socio-political factors impact digital inclusion (Chadwick et al., 2019; Lussier-Desrochers et al., 2017). Previous studies have provided methodological and theoretical frameworks for understanding digital inclusion (e.g., Chadwick et al., 2019; Lussier-Desrochers et al., 2017; van Deursen & Helsper, 2015). In the following paragraphs, we outline two digital inclusion models. van Deursen and Helsper's (2015) model describes three levels of the digital divide in relation to digital inclusion in society, while Lussier-Desrochers et al. (2017) model focuses specifically on the digital inclusion of people with intellectual disabilities. This model describes five access dimensions (internet access, sensorimotor, cognitive, technical, and social codes and conventions) needed to access the digital world while interacting dynamically with personal and environmental resources (Lussier-Desrochers et al., 2017).

The *first-level digital divide* concerns individuals' access to ICT infrastructure and includes factors such as autonomy and access over time (van Deursen & Helsper, 2015). For people with intellectual disabilities, this level can be associated with the dimension of *access to internet and technological devices* (Lussier-Desrochers et al., 2017). Access can be obtained by owning, loaning or sharing technological devices. This dimension can be a barrier for people with intellectual disabilities due to factors such as finances and costs, the need for adapted technology or specialised applications, and challenges with connecting to the internet (Lussier-Desrochers et al., 2017).

The *second-level digital divide* has to do with skills needed to use ICTs and online usage patterns (van Deursen & Helsper, 2015). For people with intellectual disabilities, this level concerns the *sensorimotor*, *cognitive* and *technical* dimensions of digital access (Lussier-Desrochers et al., 2017). The *sensorimotor skills* dimension suggests that the sensorimotor skills (e.g., visual, auditory, tactile, fine and gross motor abilities) required to use and handle ICT may be an obstacle to the digital inclusion of people with intellectual disabilities (Lussier-Desrochers et al., 2017). Moreover, the *cognitive requirements* of ICT can be a challenge and barrier for people with intellectual disabilities, leading to difficulties in understanding how the technology works, using features, selecting content and understanding information. In addition, *technical skills* related to operating and keeping devices in working conditions are also essential for digital inclusion. However, while the second-level divide has to do with skills needed to use ICTs and online usage patterns, technology itself can, by not recognising the needs of people with intellectual disability, be inaccessible. These challenges may seem basic, but they can easily become complex for people with intellectual disabilities and lead to the need for technical assistance. However, previous research has shown that although prevention of technical failures is important, for people with intellectual disabilities the environment of the user is essential in providing technical support (Lussier-Desrochers et al., 2017). Also, to overcome some of the cognitive limitations, universal design and universal accessibility rules ensuring that everyone in society can access the same digital environment have been suggested as a solution (Lussier-Desrochers et al., 2017).

The *third-level digital divide* concerns gaps in individuals' capacities to convert their internet access and use into favourable offline outcomes (van Deursen & Helsper, 2015). There are similarities between the third-level digital divide and the *social codes and conventions* dimension (Lussier-Desrochers et al., 2017). According to Lussier-Desrochers et al. (2017), there are established ways of behaving in the digital society, and individuals who do not understand these rules may be exposed to forms of victimisation and exclusion (e.g., harassment, unwanted content and identity theft). While few recommendations have been tested, potential solutions include educational programmes and individualised support (Lussier-Desrochers et al., 2017).

2 | CONTEXT

The context of this study was an Action Design Research (ADR) project which aimed to develop a self-reflective tool for people with intellectual disabilities. ADR is a research methodology within information systems that blends activities of action research and design science research (Sein et al., 2011). ADR aims to solve a practice-inspired problem through the design and development of theory-ingrained artefacts (Sein et al., 2011). In ADR, user involvement in the design process is emphasised. The self-reflective tool was meant to support people with intellectual disabilities in their transition from school to work by mapping their skills, abilities, and interests, set goals and create a CV.[1]

[1]More information about the prototype is presented in Wass et al. (2020).

TABLE 1 Overview of the design activities.

No.	Timeframe	The focus of the design activity
1	Week 1	Introducing the project and testing the first paper prototype
2	Week 12	Reviewing the first prototype
3	Week 19	Developing design elements and providing feedback on icons and wording
4	Week 20	Reviewing user login and ways to map interests
5	Week 22	Introducing the project's aim and providing feedback on design elements and icon use
6	Week 23	Developing mapping elements and categorising interests
7	Week 23	Gaining insights into gamification elements and motivation in games[a]
8	Week 36	Following up on Session 5, gaining insights into progress and rewards in games
9	Week 36[b]	Gaining insights into progress and rewards in games
10	Week 52	Refining the prototype of the tool, testing usability in a lab and testing features

[a]Gamification elements refer to using aspects of role-playing games (RPG) and by including for instance achievement badges.
[b]This session was digital due to the COVID-19 pandemic restrictions (Zoom and MIRO).

FIGURE 1 Left: Testing games in a workshop session. Centre: Introductory workshop with the participants. Right: A version of the interest mapping feature (users choose their interests, the bar visualises task progress and the mapping category is shown above the interest).

The Action Design Research project and the development of the self-reflective tool included ten design activities where teenagers with intellectual disabilities participated (Table 1).[2] The activities lasted between 1.5 and 2 h each. These activities provided a context in which we explored how participation in design activities can support digital inclusion (Figure 1).

3 | METHODS

After the design activities, we conducted additional individual and group interviews, and during the design activities, we engaged in participant observation to explore the participants' experiences of participating in the design activities. In addition, the support workers were asked to provide reflective notes after the activities. Data collection was focused on the participants' experiences during the design activities.

3.1 | Participants

Seven young adults with intellectual disabilities and eight support workers who participated in the design activities participated in this study. All the participants were recruited through the ADR project in which they were already involved. Except for the designer, neither the participants nor the support workers had prior experience with design activities. An overview of the participants with intellectual disabilities is presented in Table 2.

[2]The ADR project and problem-understanding activities are described in detail in Wass et al. (2019).

TABLE 2 Overview of the participants with intellectual disabilities.

Name	Age[a]	Gender	Design activities	Number of interviews	Relevant characteristics	Technology experience
Tomas	17–20	Male	6	5	Can write and read. Liked drawing	Has a smartphone and a computer. Good at writing messages. Likes and plays computer games
Anne	17–20	Female	7	6	Can write, had trouble reading out loud	Has a smartphone and a computer. Plays games and uses YouTube
Christin	17–20	Female	7	6	Can read and write	Has a smartphone and a computer. Uses social media, good at sending messages
Jadon	15–18	Male	3	2	Can read and write. Draws very well	Has a smartphone and a computer. Plays games on computers and consoles, uses YouTube regularly
Paul	15–18	Male	3	2	Can read. Had trouble writing	Has a smartphone and a computer. Uses social media. Plays games on computers and consoles
Victoria	15–18	Female	3	2	Can read and write	Has a smartphone and a computer. Uses social media
Mary	15–18	Female	3	2	Can read and write	Has a smartphone and a computer. Uses social media

[a]Age presented as age intervals.

The supplementary sample included designers, the participants' teachers and other support workers (for an overview, see Table 3).

In addition, the first author participated in all design activities as an observer, and the second author participated as a facilitator. Both the first and second authors were involved in planning and structuring the design activity sessions.

3.2 | Data collection

The data were collected at the location where the design activities took place, which was either the participants' school or the university (design activity 10). See Table 1 for an overview of the design activities. During the individual and group interviews, which were undertaken after the design activities, the participants were invited to talk about their experiences of participating in the design activities. The interviews with the participants were semistructured and contained open-ended questions to allow in-depth exploration. The participants were, for instance, asked the following questions: *How did you experience participating in the design activity? Did you learn anything new during your participation? Elaborate and give examples*. To improve interview quality, we used Sigstad and Garrels's (2018) recommendations and communication techniques, such as rephrasing questions, repeating, paraphrasing, silence and summarising responses. In addition, the first author, a learning disability nurse, adapted communication to suit the needs of each participant. The interviews lasted between 20 and 35 minutes each, and were audio-recorded and transcribed by the first author.

We used a field note template to structure the field notes during and shortly after the observations. Participant observations focused on describing the context, actions, nonverbal communication and the interactions between facilitators and participants. Moreover, the participants' and facilitators' comments regarding participation were also noted. Support workers and the designer provided reflective notes. After the design activities, the refective notes were sent to the first author via email. The reflective notes were used to collect information on the tasks during the workshops and on participants' perceptions and experiences of the design activities. The support workers were asked to answer questions regarding their experiences, perceptions and observations.

3.3 | Data analysis

We used thematic analysis to analyse the individual and group interviews, the field notes from the participant observations and the reflective notes by the support workers. Thematic analysis was selected as it is flexible and enables identifying, analysing and reporting patterns in the collected data (Braun & Clarke, 2006, 2013). In addition, thematic analysis facilitates rich descriptions of the data, which is useful when investigating under-researched areas (Braun & Clarke, 2006). In this study,

TABLE 3 Overview of the support workers.

Name	Role	Technology design experience	Prior experience[a]	Design activities	Number of reflective notes
Josh	Designer	Yes	Yes	6	4
Lilly[b]	Teacher	No	Yes	7	5
Sam[b]	Teacher	No	Yes	3	3
Tom	Facilitator	No	Yes	2	2
Lewis	Gamification tester	No	No	2	2
Carlos	Gamification tester	No	No	2	1
Brad	Gamification tester	No	No	1	1
Harry	Gamification tester	No	No	1	1

[a]Experience in working with people with intellectual disability before the design activities.
[b]Worked with the participants before the design activities.

TABLE 4 Examples of the analysis process.

Data extract	Condensation	Theme
'By participating in the activities, I now know how to log into the app and create a user (profile)'.	Learning new skills, using technology, increasing knowledge, technology testing	Improved digital skills and enhanced technology knowledge
'I had never tried that game before. I wish we could play longer, but I will try the game and play more at home'.	Enjoyment, new task, increased interest in games	Increased interest in technology use

TABLE 5 Mapping of identified themes and participants.

Themes	Participants						
	Tomas	Anne	Christin	Jadon	Paul	Victoria	Mary
Improved digital skills and enhanced technology knowledge	✓	✓	✓	✓	✓		
Displaying skills and competence	✓	✓	✓	✓		✓	✓
Increased interest in technology use		✓	✓		✓	✓	✓
Influencing and adapting technology	✓	✓	✓	✓			✓

the data analysis was a data-driven inductive analysis. We followed the six phases of thematic analysis recommended by Braun and Clarke (2006). Firstly, the first author listened to and transcribed the interviews. Then, the transcriptions were read multiple times, and initial thoughts were noted down to ensure familiarisation. The interview transcripts, field notes and reflective notes were then coded using a data-driven approach focusing on aspects of digital inclusion in the design activities. The initial codes were discussed by all authors to reach a consensus. Afterwards, the themes were developed, reviewed and discussed by all authors (see Table 4 for examples of a thematic analysis). To ensure rigour and quality during the analysis, the authors continually communicated throughout the data analysis to safeguard against biases. During the analysis, a chain of evidence was established, meaning all documents were stored (available to all authors). To enhance the internal validity, the findings are presented with thick descriptions and information directly from the participants.

3.4 | Ethical considerations

The study was approved by the National Centre for Research Data (648227) and the Faculty's Ethical Committee at the University. All participants received and signed an adapted voluntary informed consent form. In addition, parents or guardians were informed and asked for their consent. The participants' parents or guardians were also asked to watch for signs of wishing to withdraw from the study. We emphasised that participation was entirely voluntary and that the participants could withdraw at any time without repercussions.

4 | FINDINGS

The thematic analysis resulted in the following four themes: improved digital skills and knowledge, displaying skills and competence, increased interest in technology use and influencing and adapting technology (Table 5 maps the themes and the participants).

The identified themes are based on the participants' experiences and descriptions of gains during the design activities.

4.1 | Improved digital skills and knowledge

The participants stated that participating in digital technology design activities led to improved digital skills and technology knowledge. For instance, Tomas stated the following: '[By participating in the design activities], you learn a lot about technology'. The participants provided examples of the various digital skills that they had learned during the activities. For instance, Christin said, 'I learned how to use the menu to navigate through the app (application) and how to move forwards and backwards [instead of exiting the app]'. The participants also described improving their general knowledge of technology and technical terminology. Anne noted the following: 'I did not have any trouble using the iPad [during the design activity], but I did not know what swiping meant. But now I know [the meaning]. I had never heard that word'. In addition, the participants described acquiring technology-related knowledge. For example, Anne said, 'I have learned how to better express myself online. Now I know how to use the suggestions that pop up in apps'.

It was noted that the participants were guided through difficult tasks and aspects of ICT, instead of the support workers doing or solving the tasks for them. In addition, the participants stated that gaining more context-specific knowledge and technical terminology. For instance, Anne said: 'By participating in the activities, I now know how to log into the app and create a user [profile]'. Also, Anne explained, 'While testing the applications, I was asked to add information about a contact person, and I did not know what that meant. The designer explained that it meant family or a friend or even my teacher. So now I know'. Lastly, the design activities were perceived as an environment in which the participants learned more about both the technology and the design process. For instance, Christin said, '[by participating], I now know more about how apps are developed'.

4.2 | Displaying skills and competence

The participants exhibited their skills and competence and challenged assumptions and prejudices by participating in the digital technology design activities. For instance, Jadon talked about playing games: 'It was not difficult to try games because I play the same games at home. I have played similar games for a long time'. Moreover, it was observed that some participants were familiar with certain tasks and helped one another during the design activities. For example, one participant helped the others with connecting and using the suggestion board on MIRO.[3] Moreover, during the gamification workshop, a participant who had played the game before helped explain how to play and also how to access the game after the design activities. The participants also exchanged information about social media use, digital applications and platforms (e.g., YouTube, Facebook, Snapchat) and how to use them. The social setting of the activities may have also led to peer-to-peer learning.

Furthermore, the participants found it important to show that they could cope with using technology in the design activities. The participants described participation as an opportunity to prove their ICT competence. Moreover, the participants described wanting to challenge prejudices suggesting people with intellectual disabilities are unable to participate in design activities. For instance, Christin stated, 'It is important to show that we [people with intellectual disabilities] can also help in creating technology that can help others'. The two teachers, Lilly and Sam, also described similar experiences. Lilly wrote in a reflective note, 'I think they loved participating today. They love playing computer games, and they also had a sequence in which they tried new games [which they liked]'. However, the teachers provided the participants and researchers with technical support during the design activities—for instance, assisting the participants with connecting to the internet and logging into and using services such as MIRO and Zoom.[4]

The support workers reported that participation in the digital technology design activities opened up new possibilities for assessing the participants' ICT skills and knowledge. They described getting to know the participants in new ways. For example, Sam stated the following: 'I get to know the participants differently by following them and observing their participation in the technology design activities. It is not like we speak about these things [technology] often'. Furthermore, a support worker stated gaining knowledge about the different types of technologies that the participants used and how. From a more practical perspective, the participants described using ICT to coordinate their design activity participation. For instance, the support workers used text messages and phone calls to contact the participants before and after the design activities.

4.3 | Increased interest in technology use

The participants stated that participation in digital technology design activities encouraged them to use technology and increased their interest in the opportunities offered by technology. For instance, in a reflective note written after an activity, Josh noted, 'they were really interested in technology [and that's great]'. More specifically, the participants were interested in using the tool that they had helped develop. For instance, Anne stated the following: '[The main motivation for participating] is that I can use the app myself if it gets developed'. Moreover, the participants believed that the technology developed could be useful for others with intellectual disabilities. Tomas said, 'It has been fun that we got to participate in developing an app. An app that can help others'.

[3]MIRO is an online whiteboard in which one can create notes and designs as well as communicate and collaborate.

[4]Zoom is an online platform that enables communication via chat, audio and video.

The participants also suggested that they were interested in trying out other applications and games that they discovered in the digital technology design activities. For instance, Paul stated the following: 'I had never tried that game before. I wish we could play longer, but I will try the game and play more at home'. It was also observed that the participants also exchanged knowledge of other games, applications and internet-based solutions during the digital technology design activities, with the intent of trying them out later.

4.4 | Influencing and adapting technology

The participants appreciated the possibility of influencing the technology and making it more useful for themselves and others. They described their suggestions as important in designing a tool that supports others with the same needs as themselves. For instance, Christin said, 'I think that our contributions are important and will help make the technology better for others with [intellectual] disabilities'. The participants also expressed their agency by arguing and advocating for adaptations, as summarised by Tomas: 'We gave many suggestions and much input throughout our participation'. Here, agency refers to making choices and decisions based on preferences and influencing the activities and technology.

Moreover, the participants described identifying weaknesses and suggesting new features, thus contributing to adapting the design for people with intellectual disabilities. For instance, Tomas proudly stated, 'I even think I was the one who suggested the use of smiley faces [as a mapping feature]'. In addition, the participants contributed to the design by providing feedback on and insights into different design elements, generally shaping the artefact and informing its design. Furthermore, the participants' feedback highlighted different individual and contextual needs as well as the importance of customisable solutions.

5 | DISCUSSION

In our study, we analysed the interviews conducted with people with intellectual disabilities by focusing on digital inclusion. In addition, the field notes from the participant observations and reflective notes by the support workers were also analysed. The data analysis resulted in four themes. Our study suggests that participation in digital technology design can support digital inclusion through improving digital skills and knowledge, displaying skills and competence, increased interest in technology use and influencing and adapting technology. In the following section, we discuss our findings and highlight the implications for teachers, designers, facilitators and researchers.

5.1 | Providing new opportunities

Our findings indicate that participation in digital technology design can promote the digital inclusion of people with intellectual disabilities by strengthening individuals' ICT abilities. Although the participants in our study had access to ICT and regularly used devices such as mobile phones and tablets, having access to ICT is only one aspect of digital inclusion and should be considered along with other factors, such as digital skills and competence (Chadwick et al., 2013). Our findings show that participation in digital technology design activities can help people with intellectual disabilities towards overcoming the second-level digital divide (van Deursen & Helsper, 2015) and the sensorimotor, cognitive and technical dimensions of digital access (Lussier-Desrochers et al., 2017). For instance, the participants learned new ICT-related terminology, how to navigate the application and features such as logging in and creating a user profile. The participants gained hands-on experience with ICT during the design activities, which is important given that digital exclusion due to limited skills is related to a lack of training and hands-on experience (Helsper, 2008). Although the focus of the activities was not to learn about technology, the activities were described as a process that promoted 'learning by doing'. For instance, the participants were guided through difficult ICT-related tasks instead of the tasks being solved for them. Therefore, participation in design activities can help overturn the belief that people with intellectual disabilities are unable to learn using ICT (Chadwick et al., 2013).

Enhancing the digital skills of people with intellectual disabilities is essential because limited digital skills and usage patterns are barriers and may lead to negative attitudes, fear, and low levels of confidence and trust in ICTs. Design activities may offer a unique learning opportunity for participants to learn and improve their digital skills and competence on their own terms. For instance, our participants described being viewed as experts during the design activities. This perception is important, as people with intellectual disabilities often have support workers or family members constraining their digital inclusion and limiting their agency (Barlott et al., 2020). Participation in digital technology design activities can help overcome the barriers related to technical skills that users need to operate ICT as well as the challenges related to understanding ICT and the related features. These positive outcomes can support the digital inclusion of people with intellectual disabilities, making them less dependent on carers and proxies when engaging with ICT.

Our study suggests that digital technology design activities can help people with intellectual disabilities exhibit their skills, acquire new competences and increase their confidence in using ICT through positive technology-related experiences. Research on digital inclusion has shown that some users may be disadvantaged because they feel that they do not have the skills to use ICT (Helsper, 2008). Moreover, low perceptions of one's personal skills, which may be based not on one's real skill level but on negative attitudes towards technology, may lead to self-exclusion (Helsper, 2008). Participation in digital technology design activities, which provides positive ICT-related experiences, is one means for changing such perceptions and attitudes. In addition, ensuring the beneficence and enjoyment of technology design activities is particularly important for people with intellectual disabilities (Benton & Johnson, 2015). In our study, the participants described enjoying testing the new tool, challenging assumptions and proving their ICT competence. In fact, Helsper and Eynon (2013) argued that confidence can be more important than actual ability when it comes to ICT engagement. Therefore, when

tackling digital exclusion, it is important to foster people's engagement with ICT and broaden the number of things that people do when using ICT (Helsper, 2008). Our study suggests that participation in digital technology design activities can increase interest in technology and expand ICT use. For instance, the participants described an intent to later try out applications and games they discovered during participation later on. This finding is in line with previous studies, which showed that attitudes towards ICT, including interest, motivation and trust, can directly affect access, skill development and usage (van Dijk, 2005; van Deursen & van Dijk, 2015).

In our study, the participants and support workers exchanged information through messages and phone calls when coordinating participation. The participants and support workers gained training in ICT use and maintaining online contact with one another. Such ICT-enabled communication is important because it may foster digital communication and ICT use between people with intellectual disabilities and support workers. In line with previous research, prior experience in ICT use can facilitate digital inclusion (Chadwick et al., 2022).

5.2 | A mapping opportunity

Our study suggests that facilitation by support workers during design activities can be a learning process for both support workers and people with intellectual disabilities. To promote the digital inclusion of people with intellectual disabilities, support workers need to provide them with sufficient assistance (Chadwick et al., 2022). By functioning as an arena for exhibiting skills and knowledge, digital technology design activities can provide support workers with information and insights for better adapting ICT support for people with intellectual disabilities. First, support workers sometimes do not know the levels of digital literacy and digital competence possessed by people with intellectual disabilities. During design activities, support workers can gain knowledge of how and what types of ICT people use and what obstacles they have to traverse when interacting with digital technologies and digital content. It is important to recognise that two people with similar disabilities can have different preferences, skills and interests regarding ICT. Therefore, the knowledge gained by support workers can support digital inclusion, as support workers can accommodate ICT use and adapt their technical support and mentoring to individual needs. Also, the design activities can be a platform for guidance and support for appropriate use of ICT, thus offering a potential solution to the third-level digital divide (van Deursen & Helsper, 2015) and the social codes and conventions dimension (Lussier-Desrochers et al., 2017).

Second, a fundamental barrier to digital inclusion is linked to the attitudes of carers, support workers and society. By allowing people with intellectual disabilities to exhibit their skills and knowledge, digital technology design activities can function as an arena not only for identifying barriers but also for understanding what participants can master. Therefore, design activities can help change the attitudes of support workers, designers and other facilitators. This is particularly important for people with intellectual disabilities because the attitudes of professional and family carers can affect their online access and activities (Chadwick et al., 2019).

5.3 | Bridging a gap

People with intellectual disabilities face challenges in fully benefitting from ICT because the digital environment is not adapted to their abilities and needs (Lussier-Desrochers et al., 2017; Rocha et al., 2012). In line with recent research, adapted software programmes and applications have been developed to meet the needs of people with intellectual disabilities (Davies et al., 2015). More accessible ICT can support digital inclusion by overcoming divides in skills and usage patterns (van Deursen & Helsper, 2015) and the lack of accessible and adapted technology and websites (Chadwick et al., 2013). By allowing participants to influence the technology being designed, digital technology design activities may support digital inclusion by developing technology that considers the cognitive, visual, auditory, tactile, fine and gross motor abilities of people with intellectual disabilities.

In our study, the participants described influencing technology by addressing weaknesses and suggesting new features and, in that way, adapting the designed technology. While the predominant approach to designing technology for all is designing solutions according to the principles of Universal Design, the participants highlighted different individual and contextual needs as well as the need for customisable solutions. This is supported by Lussier-Desrochers et al. (2017), who stated that adapted technological devices can help overcome several barriers that people with intellectual disabilities face due to sensorimotor skills. Adapting technology solutions improves users' cognition by offering, for instance, audio, textual or visual alternatives. Moreover, people with disabilities may have different needs and preferences regarding ICT that may not necessarily be dictated by their disabilities. For instance, in content presentation, some prefer audio and text together, while others prefer only text. Allowing users to influence and test the technology may improve the adapted technology's capacity to fit people's needs and abilities. This is supported by the existing literature, which states that user involvement can positively impact user satisfaction, system performance and quality (Bano & Zowghi, 2015; Cinquin et al., 2020). In addition, participation in digital technology design activities can support digital inclusion by preventing potential technical failures. Preventing technical problems is essential, as ICT is prone to technical problems and failures, which may lead to users underusing or giving up on the technology (Lussier-Desrochers et al., 2017).

5.4 | Implications and future research

This study sheds light on how digital technology design activities can support the digital inclusion of people with intellectual disabilities. We suggest that, given the positive influence that digital technology design activities can have on digital inclusion, researchers and

designers should involve people with intellectual disabilities when designing technology. This study shows that when people with intellectual disabilities are viewed as experts and are given the opportunity to learn by doing, digital technology design can support towards digital inclusion. However, it is essential to establish a relationship with the participants and to involve support workers during design activities.

Although our study has focused on activities related to the design of a self-reflective tool, more research is needed on how participation in the design activities of other technological solutions could support digital inclusion. Furthermore, there is a need for more research on how different design structures, techniques and frameworks in design activities can be adapted to support elements of digital inclusion. Thus, there is a need to explore how digital technology design activities can be used for educational purposes for people with intellectual disabilities and how education can build upon projects as an area for enhancing digital inclusion. While findings from this study illustrate why it is important to involve people with intellectual disabilities in digital technology design activities, more research is required to identify and examine the structural barriers that prevent participation.

5.5 | Limitations

This study has potential limitations that need to be considered. Although the number of interviews and participants was sufficient for a small study (Braun & Clarke, 2013), this study has a limited number of participants. People with intellectual disabilities are not a homogeneous group, and the design activities were adapted to participants with certain abilities and interests. As a result, the participants' abilities, age, interests and experiences with technology may have influenced their experiences and the results of our study. Moreover, one can assume that the participants and support workers in this study were more capable in using technology, and therefore experiences of people with for instance severe or multiple disabilities are not reflected within the research or support workers with limited digital literacy. In addition, we did not compare or explore other design settings and design activities. The transferability of the results may therefore be limited to specific settings. During the digital technology design activities, the first author participated as an observer and the second author as a facilitator. This provided us with access to information and observations that would otherwise have been unavailable, but it may have influenced the study's results.

6 | CONCLUSION

Digital inclusion is a complex and multifaceted phenomenon. This article examined whether and how participation in digital technology design activities can promote the digital inclusion of people with intellectual disabilities. We contribute with new insights into how digital technology design activities can support towards the digital inclusion of people with intellectual disabilities. While participation in digital technology design activities is not the main approach to promoting digital inclusion for people with intellectual disabilities, our study showed that digital technology design activities can support digital inclusion by adapting technology solutions to the needs of people with intellectual disabilities, strengthening individuals' ICT capacities and improving the knowledge of support workers. Participation in digital technology design can help towards overcoming barriers related to the access to the internet and technological devices dimension, to the sensorimotor, cognitive and technical dimensions of digital access, and to the social codes and conventions dimension. Our findings suggest that by participating in digital technology design activities, both individuals with intellectual disabilities and support workers can gain knowledge and competencies that can support the digital inclusion of people with intellectual disabilities. Our study calls for further engagement with and involvement of people with intellectual disabilities and supports workers in digital technology design activities to promote digital inclusion.

AUTHOR CONTRIBUTIONS

All authors have made substantial contributions to the conceptualisation, methodology, formal analysis and the writing of the article.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

Research data are not shared.

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