



# Digital accessibility tools and training and the DA4You course: views and experiences of users with disabilities

Sharon Black<sup>1</sup> · Carlos de Pablos-Ortega<sup>1</sup>

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## Abstract

Digital technologies are now ubiquitous in our lives and it is of critical importance that people with disabilities benefit from full and equitable access to the digital world. However, digital accessibility training for users with disabilities is lacking, and there is little research on developing such training focusing on ways to use the broad and growing range of digital accessibility tools available today. The current study investigates the practices, views and experiences of users with disabilities regarding digital devices, accessibility tools and training. Data were collected from 91 participants with a range of disabilities using a questionnaire and 14 participants took part in a semi-structured interview. The findings confirm that while users with disabilities are making use of a wide variety of technologies and accessibility tools, digital accessibility training for such users is inadequate, with participants experiencing gaps and shortcomings in the training and support provided from their early years onwards, including at school, university and in their adult lives. Such gaps and deficiencies reinforce the digital divide between users with disabilities and non-disabled users. Participants gave several recommendations to improve digital accessibility training. The research informed the design of the training created as part of the DA4You project, presented in this article, which was positively evaluated by participants overall. However, greater efforts are needed to improve digital accessibility training for all users with disabilities, who are keen to have access to more and better training opportunities. The onus is on educators, trainers, administrators and policymakers, etc. to make this a priority.

**Keywords** Digital accessibility · Training · Assistive technology · Users with disabilities

## 1 Introduction

Given the ubiquity of digital technologies in people's lives, societies globally have much to gain from creating a more accessible digital world. According to the World Health Organisation 16% of people globally live with a disability [1], which equates to one in four European adults. In the UK there are approximately 14.6 million people with disabilities, with just over one in five citizens (22%) reporting a disability in 2020–2021 [2]. Moreover, the number of people in the UK who identify as disabled is growing, with three million more people reporting a disability than a decade ago [2]. It is essential that users with disabilities

have full and equitable access to digital technologies and that societies adopt and foster what Greco has termed “the poetic model of agency” [3], whereby all stakeholders have a voice, including users of digital accessibility provisions, and are fully participating, active agents and co-creators in digital accessibility processes.

However, there is a dearth of training to enable users with disabilities to fully benefit from the abundance of digital accessibility tools<sup>1</sup> and features on offer nowadays. Additionally, studies on developing such training are scarce, and research on the practices, views and experiences of users with different disabilities regarding digital accessibility tools and training is limited. Moreover, existing research in this area has largely taken a particularist rather than a

✉ Sharon Black  
sharon.black@uea.ac.uk

<sup>1</sup> School of Media, Language and Communication Studies, University of East Anglia, Norwich, UK

<sup>1</sup> The digital accessibility tools and features included in this project are: audio description, digital braille, easy read materials, large print materials, reading and writing tools, screen magnifiers, screen readers, sign language on TV/via video, speech recognition tools, subtitles/captioning and other text-to-speech and speech-to-text tools.

universalist approach by focusing on one disability only. Therefore, the present study contributes to filling these gaps by examining the practices, views and experiences of users with disabilities regarding digital devices, accessibility tools and training. This research informed the design of the digital accessibility training also presented in this article, which was created as part of the DA4You project <sup>2</sup>.

## 2 The social model of accessibility

The theoretical framework underpinning the design of the digital accessibility research and training presented in this article is the social model of accessibility [3]. This model is linked to the social model of disability, according to which disability is understood as a form of social exclusion imposed on people with disabilities by a society which oppresses and disables them [4, 5]. Therefore, the onus is on society to change and remove barriers to the participation of people with disabilities. The right to active participation is embedded in the social model of accessibility, with all stakeholders having a voice and a role in the co-construction of solutions to access problems [3]. Moreover, the social model of accessibility is reflective of three fundamental shifts occurring in the various research areas focusing on accessibility: (1) from *particularist accounts* to a *universalist account* of access; (2) from *maker-centred* to *user-centred* approaches; and (3) from *reactive* to *proactive* approaches [6].

The first shift means that while in the past access was thought to solely or principally involve particular and distinct groups of people, it is now understood to be relevant to all human beings. The second shift relates to the evolution in understanding that users are “bearers of valuable knowledge for the investigation of accessibility processes and phenomena” [6], and that makers are not the only knowledgeable agents involved. The third shift is the move away from thinking of accessibility only at the very last stages of production, and instead placing accessibility at the heart of the development process so that it is considered right from the conception or start of the design phase [6, 7].

The digital accessibility training and underpinning research presented in this article have been designed in line with the universalist account of access: learning about digital accessibility principles and tools is conceived as being of relevance and use to all, and not just to particular subsets

of users. However, it should be noted that, while a universalist approach understands access as being applicable to all, it does not view users as a single, homogenous group of people, nor does it equate to providing one universal form of access that is somehow suitable for all [8]. Disability is understood within the paradigm of human variation, whereby difference is not an exception, but rather a natural part of life, and users’ individual needs and specificities are taken into account [3, 8, 9]. Therefore, we sought to design our course and research with the training and access needs of users with a range of different abilities and disabilities in mind, while at the same time taking into consideration a variety of specific access needs.

Moreover, following Moores [8], this work is informed by the theories of intersectionality <sup>3</sup>, with its focus on social inequalities, and of social justice. Like Moores, we believe that since “many different intersections may be critical in shaping experience”, these could be revealed and discussed more naturally in conversations about access and accessibility during our training and interviews with participants “rather than trying to prescriptively determine them in advance” [8]. Therefore, the survey reported on in the current work and the invitation to take part in the research interviews were addressed to all users of digital accessibility tools. Moreover, social justice is central to the present work, due to its “demand for a fairer and more equitable world with respect to how wealth, opportunities and privileges [including knowledge] are distributed within society” [8]. When certain users are not able to make full use of digital devices, tools and content due in part to a lack of accessible training on how to do so, this is an example of social injustice which the current work aims to contribute to tackling. As shown in Sect. 7, our training course was open to people with Specific Learning Difficulties (such as dyslexia, autism, and attention-deficit/hyperactivity disorder, or ADHD), physical disabilities, and/or who were d/Deaf, blind, or partially deaf/sighted.

The research and training discussed in this article also sought to be reflective of the second shift identified above, from maker-centred to user-centred approaches, since we understand users to be experts in their own experiences who can contribute valuable knowledge. Thus, the training was tailored for users to focus on how they wish to use digital devices and accessibility tools, in addition to learning about how people with different disabilities can benefit from using them. Moreover, the training aimed to be learner-centred in that it focused on what the learners do and their learning, rather than on what the trainer does [11]. The accessibility requirements of learners were also at the centre of the design process for the training right from the outset, and

<sup>2</sup> The Digital Accessibility for You (DA4You) project (2019–2021; ref: KA205-2018-022) was financially supported by the Erasmus+ Programme of the EU and aimed to empower young people with communication difficulties to use digital media for democratic participation in the debate on accessibility across disability, geography and language.

<sup>3</sup> Intersectionality is “a way of understanding and analysing the complexity in the world, in people and in human experiences” [10].

we sought to integrate them into every stage of the design and running of the course. In this way, we aspired to take a proactive approach, in line with the third shift.

### 3 Advances in digital accessibility and new forms of digital exclusion

In many ways, the rapid development and widespread availability of sophisticated digital technologies have opened up new possibilities for people with disabilities to access information and communicate with others. Moreover, digital accessibility is now a necessary requirement and a “proactive principle” [12] for the fulfilment of the human right of all citizens to have full, equal use and enjoyment of digital technology and content. This requirement is covered by international and European legislation, such as the UN Convention on the Rights of Persons with Disabilities (CRPD) 2006, the Audiovisual Media Services Directive 2010, the European Accessibility Act 2019, the Web Accessibility Directive 2016, and in the UK, the Equality Act 2010. However, continued efforts are needed to ensure that people with disabilities can fully participate as digital citizens. In addition to creating new opportunities, the digital revolution is also reinforcing existing barriers and inequalities and creating new ones [6, 13, 14], leading to “forms of societal discrimination” [14].

In the UK, a significant number of the general population is lacking essential digital skills. An estimated 11 million people lack basic digital skills, and 36% of workers do not have essential digital skills for work [15]<sup>4</sup>. Within this challenging context, users with disabilities are facing greater barriers to accessing the digital world than non-disabled users. In 2020, 14.9% of people with disabilities had never used the internet, compared to 6.3% of the whole UK population [16]. Moreover, people who identify as having an impairment are 28% less likely to have the digital skills needed for everyday life, with people with vision and hearing disabilities having the lowest levels of digital skills [15]. Considerable efforts need to be made to close the digital divide between people with disabilities and non-disabled people, to foster digital inclusion and support users in acquiring digital skills.

People with disabilities can especially benefit from the effective use of digital tools and the online world “to help overcome disabling barriers they face caused by societal

attitudes, organisation and structuring” [17]. Moreover, assistive technology (AT) has become much more accessible over the last two decades, having evolved from primarily consisting of expensive tools purchased separately by users from specialist companies in addition to PCs and other software, to the wide variety of digital accessibility tools and features that are available at a much lower cost nowadays to download on a range of devices, or which already come built into devices and platforms [18]. However, a majority of people globally who need AT still do not have access to it, which significantly impacts the education, livelihood, health and wellbeing of individuals, families, communities and societies [19]. Among several reasons behind the digital exclusion faced by people with disabilities, including a lack of affordability or availability, lower incomes, higher unemployment, and social exclusion, is that of limited IT training opportunities [17]. It is of vital importance that more and better training be provided to users with disabilities that empowers them to fully enjoy the benefits of the digital world. The training presented in the current work aims to contribute to this endeavour.

In terms of research in this area, studies on digital accessibility and training for learners with disabilities has principally focused thus far on individual disabilities rather than adopting a universalist approach, and has investigated topics such as developing accessible e-learning platforms and environments [20–22], MOOCs [23, 24], making accessible digital educational materials [25] and digital tools and apps for accessible learning [26–28]. However, there is little research on developing training for users with disabilities on making full use of the plethora of digital accessibility tools and features available nowadays.

Before designing training for this purpose, it is important to first investigate users’ practices, attitudes and experiences regarding digital technologies and accessibility tools. However, it was again found that this important issue has received too little attention from researchers, and that the existing studies in this area tend to focus on one disability only, adopting therefore a particularist rather than a universalist approach. Although a small number of studies have included respondents with a range of different disabilities [e.g., 29], most existing research focuses on users who are blind or partially sighted [see, for example 30–32], with fewer studies conducted with deaf and hard of hearing users [e.g., 33, 34] and little research with users with other disabilities. Therefore, the current study addresses this gap by providing new evidence on the practices, views and experiences of users with a range of different disabilities regarding digital technology, accessibility and training, as detailed below.

<sup>4</sup> To be considered as having Essential Digital Skills for Life, an individual must be able to do seven foundation level tasks, which include finding and opening applications/programmes on a device, using different menu settings and updating passwords, as well as demonstrating ability in five Life skill categories, including transacting, problem solving and being safe and legal online [15].

## 4 Methodology

The present article presents findings from questionnaire and interview research conducted as part of the Digital Accessibility for You (DA4You) project. The main aim of this research was to investigate disabled participants' use of digital devices and accessibility tools, and their experiences of and attitudes towards digital accessibility training. It also sought to determine what improvements participants think should be made to digital accessibility training and what kind(s) of training they feel they would benefit from having greater access to. Moreover, the survey and interview findings informed the design of a digital accessibility training course. This research was reviewed and approved by the General Research Ethics Committee (GREC) of the University of East Anglia, UK on 18 June 2019. The University of East Anglia's core principles for ethical research are in line with the Economic and Social Research Council's (ESRC) *Framework for Research Ethics* [35].

### 4.1 Survey research

The survey was made available online via the SurveyMonkey platform and was distributed via email, social media and in person, with the assistance of user associations and professional networks<sup>5</sup>. It was also made available in print, in Microsoft Word and Adobe Acrobat (.pdf) formats and in large print to make the survey accessible to respondents with low vision. Respondents were also offered the option to complete the questionnaire with the assistance of the research team via video/telephone call or in person, where possible. The survey was designed to take approximately 15 min to complete and consisted of 12 questions<sup>6</sup>. Almost all questions were closed-ended, listing defined responses to choose from by selecting radio buttons or checkboxes, for ease of completion. Some questions provided a Likert scale for frequency of use or to rate accessibility. Comment boxes were also included for participants to add extra information, with the aim of gathering qualitative data to complement the quantitative data collected.

The first five questions asked for information about participants' age, disabilities and first language. The second part asked seven questions, which covered participants' use of digital devices, such as smartphones, PCs, tablets, smart speakers, games consoles, and wearable technology, and

their use of digital accessibility tools. The digital accessibility tools listed in the questions are shown in Fig. 4. Moreover, they were asked about any training they have received in using these digital accessibility tools, the accessibility of social media platforms, and any improvements they would like to see in digital media and web accessibility.

### 4.2 Participants

The survey was addressed to users of digital accessibility tools. A total of 91 participants took part in the survey. Figure 1 presents a pie chart with proportions of different age groups of participants. Figure 2 shows a bar chart representing the disabilities reported by respondents. Respondents were able to select multiple categories. The chart reveals that respondents reported a wide range of disabilities, with the largest number, almost half (39), indicating that they are blind or partially sighted (BPS), 15 stating that they are deaf or hard of hearing, and 12 reporting that they are dyslexic; 11 respondents reported living with ADHD and 9 with autism. Smaller numbers of between 1 and 5 for each category reported a range of other disabilities including dyspraxia, dyscalculia, ASD, dysgraphia, Down syndrome, cerebral palsy and Lowe syndrome.

### 4.3 Semi-structured interviews

Semi-structured interviews were conducted with 14 participants aged 21–60 years, between March 2020 and February 2021. Eight participants reported that they are registered blind and one indicated that they are partially sighted. Four participants stated that they are dyslexic, three indicated that they have ADHD, and one reported that they are autistic. One participant reported that they have dyspraxia, two reported having dysgraphia or dyscalculia, and one participant has a physical disability and uses a wheelchair. The interviews were conducted by telephone or via Zoom and varied between approximately 30 min and two hours in duration. The interview data were transcribed using transcription software, and transcriptions were anonymised by allocating an identification code to each participant. All transcriptions, recordings and personal data were stored securely in a locked cabinet and on GDPR-compliant cloud storage available through the University of East Anglia. While the interviews covered several topics related to digital accessibility tools and training, only the data related to training will be reported on in the present article.

<sup>5</sup> A list of local, regional and national charities, associations, community groups and service providers for people who are d/Deaf or hard of hearing, blind or partially sighted and people living with dyslexia or other Specific Learning Difficulties was compiled and contacted to invite their members/contacts to complete the survey.

<sup>6</sup> The survey was piloted with three respondents during a focus group held at a local further education college prior to data collection.

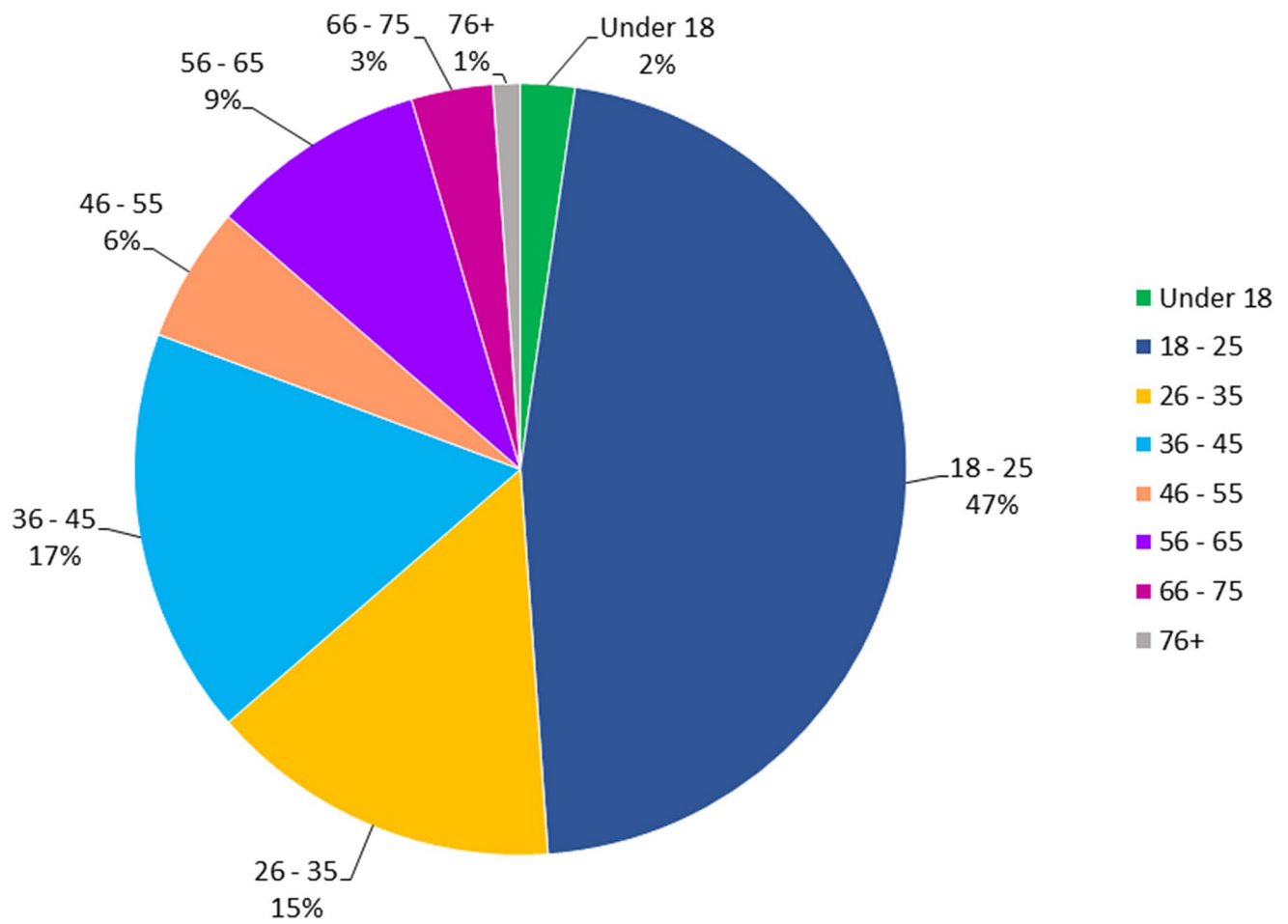


Fig. 1 Pie chart showing percentages of survey respondents according to age category

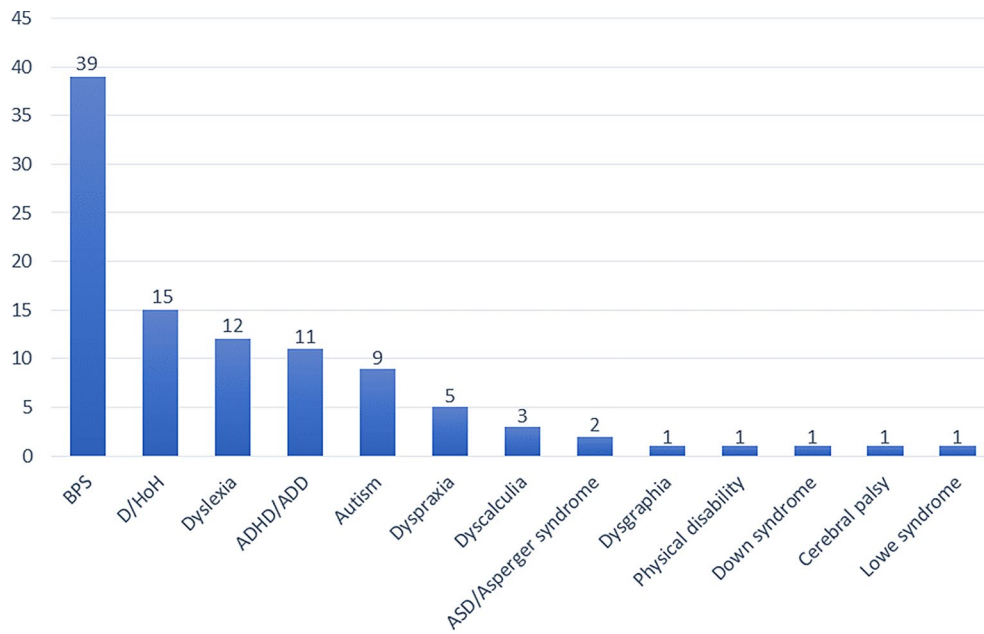


Fig. 2 Bar chart representing disabilities reported by survey respondents (n=84)

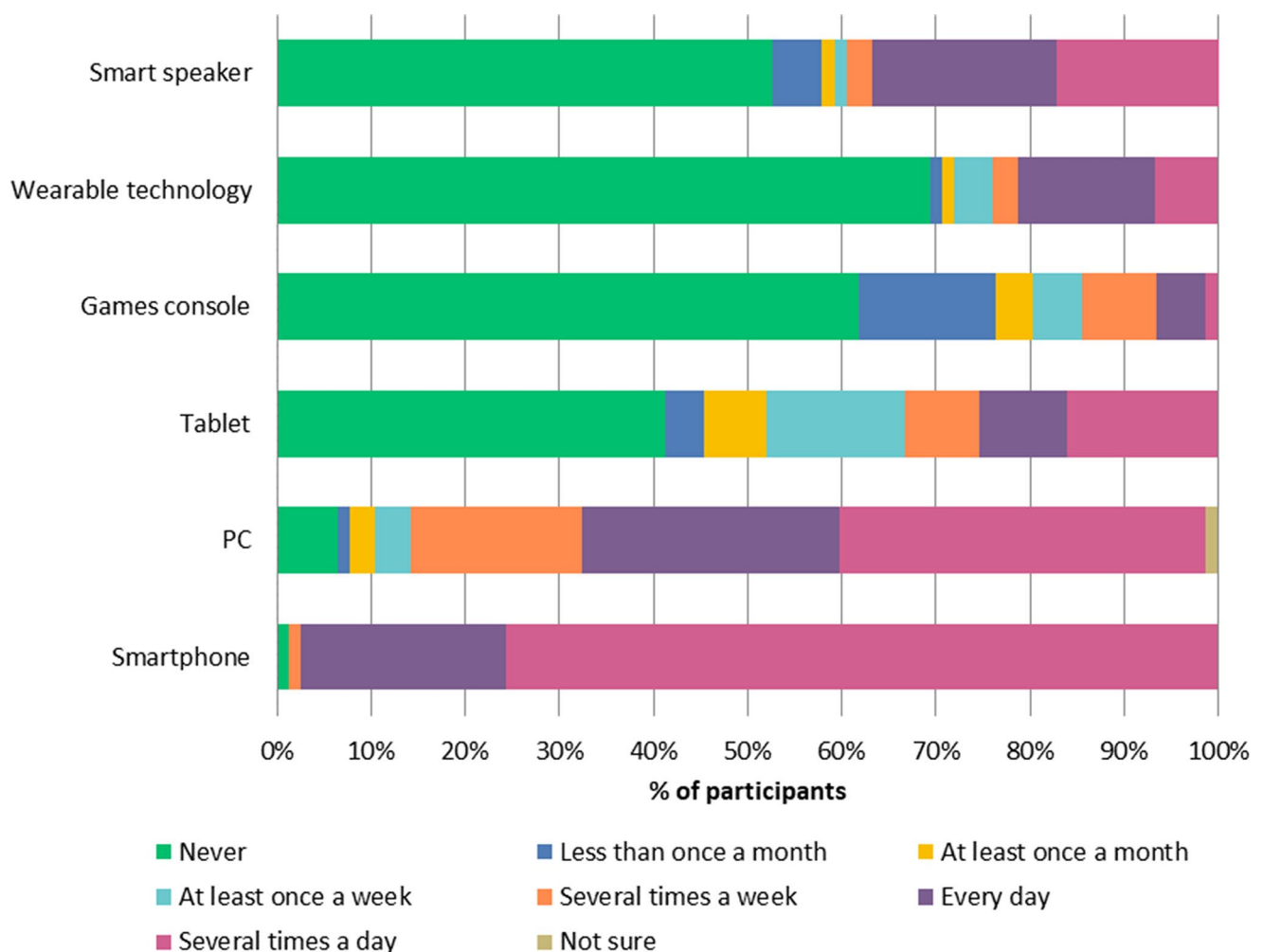
## 5 Results

### 5.1 Questionnaire results

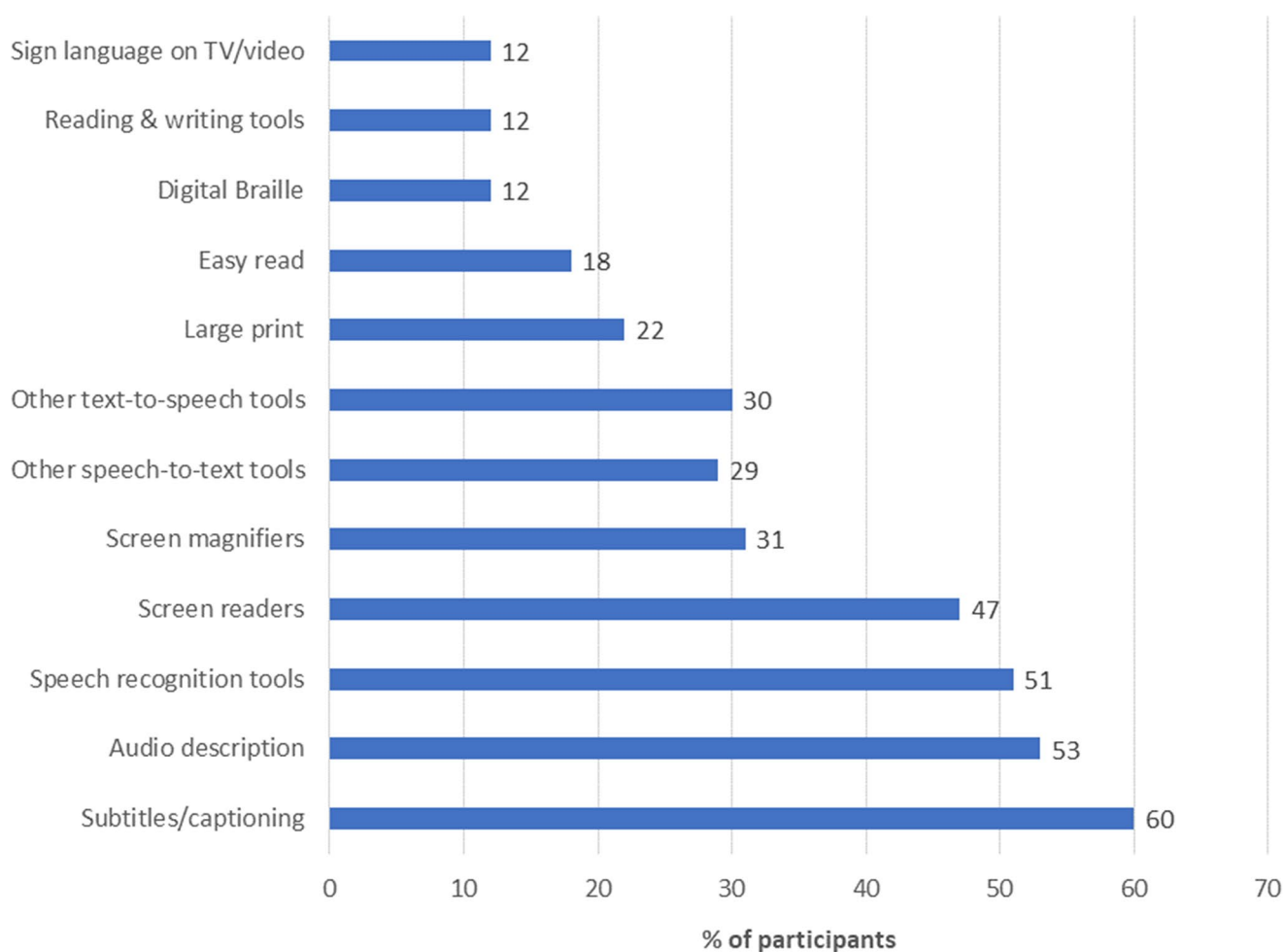
This section presents findings from the survey data on participants' use of digital devices and accessibility tools, and on the training they have received, if any, in using such tools. It should be noted that as this research was conducted in the UK, the results reflect a high-income setting. Figure 3 presents a stacked bar chart showing the frequency with which participants use a range of digital devices. What stands out in terms of the trends presented in this chart is that the two devices participants use most often by far are smartphones and PCs, with PCs used somewhat less frequently than smartphones. Almost all participants (97%) report using a smartphone every day or several times a day, while a large majority (84%) report using a PC several times a day, every day or several times a week. It is also apparent from Fig. 3 that a majority (59%) use tablets, almost half (47%) use smart speakers, and a sizeable minority use games consoles

(38%) and wearable technology (31%). Interestingly, the chart also shows that adopters of the newer wearable technologies and smart speakers tend to be frequent users of these devices, with 78% of smart speaker users and 70% of wearable technology users using these devices every day or several times a day. A few participants also reported using braille notetakers/displays and smart TVs.

In terms of digital accessibility tools, Fig. 4 reveals that the most widely used are subtitles, audio description, speech recognition and screen readers, with almost 50–60% of participants indicating that they use these tools. Figure 4 also shows that a significant minority of approximately 20–30% of participants use screen magnifiers, other speech-to-text and text-to-speech tools, and large print, and that around 10–20% use easy read materials, digital braille, reading and writing tools and sign language on TV or video. Interestingly, although only 15 participants reported being deaf or hard of hearing (see Fig. 2), the most widely used accessibility tool is subtitles. Participants who reported using subtitles include 8 of the 9 participants with autism, 6 of the



**Fig. 3** Stacked bar chart showing the frequency of participants' use of digital devices



**Fig. 4** Bar chart showing the digital accessibility tools used by respondents

participants with dyslexia, and 11 participants who reported having ADHD, Asperger syndrome, cerebral palsy, Down syndrome, dyscalculia, dysgraphia, dyspraxia, Lowe syndrome, or a physical disability. Furthermore, participants with different disabilities were found to use speech recognition, text-to-speech and speech-to-text tools.

Overall, it is apparent from Fig. 4 that participants make use of a wide range of different digital accessibility tools. However, as regards training in using the tools, on observing Table 1 it becomes evident that while almost half of the participants have received some form of training on using screen readers, and over one third have learned about using speech recognition tools, a large majority have received no training on any of the other digital accessibility tools listed, with very small percentages overall shown in Table 1 for the different tools and avenues for training.

Moreover, the open-ended survey responses on training were found to be consistent with these results, as several participants identified a dearth of training and a consequent knowledge gap on digital accessibility tools. One participant commented: “I’ve not really had any training on anything,

it’s always been a struggle to get the training” and another stated “on reflection from this survey I have come to realise how odd it is that nobody has offered or signposted me to any training whatsoever”. In the absence of formal training, several participants report being self-taught digital accessibility users, often with the assistance of friends or other contacts, and of information and tutorials online. This learning process has been described by participants as an exercise in trial and error, as “bumbling about” or “just muddling along until I work it out”.

Participants provided several suggestions for filling the gap in digital accessibility training. Several identified a need for more “training for all and early”, for digital accessibility to be taught to all children, throughout the education system from an early age. One found the training they had received to be too general, and stated that it would be useful if such training focused on specific technologies. Others reported having received some training as students as part of their Disabled Students’ Allowance (DSA) provision<sup>7</sup>, but some

<sup>7</sup> Disabled Students’ Allowances are funding provided by the UK government to students with disabilities or health problems to support

**Table 1** Training received by participants in digital accessibility tools (% participants)

	Primary education	Secondary education	Further education	Higher education	Association/charity	Workshop	Online course/tutorial	Product manual	None
SLI on TV/video	1	0	0	4	3	3	4	0	85
AD	4	1	1	4	3	3	3	3	78
Subtitles	0	0	1	12	0	1	8	1	77
Screen reader	5	2	6	5	13	3	6	5	55
TTS	0	1	3	1	4	1	7	3	80
Screen magnifiers	4	3	1	0	6	3	1	1	81
Speech recognition	0	3	3	5	4	9	7	5	64
STT	0	0	0	4	0	2	4	3	87
R&W tools	1	1	3	1	1	3	6	0	84
Digital Braille	4	4	1	1	5	0	3	4	78
Large print	6	4	0	0	3	0	1	0	86
Easy Read	5	1	1	1	1	0	0	0	91

pointed out that only a few hours of this training were provided, with one commenting that “Software can be complicated to understand and therefore take time to work out”.

In terms of the training that the survey participants would like to receive, a large majority would be interested in learning to use different digital accessibility tools (79%), including for jobs (73%) and social media (75%), and would like to learn about their rights in terms of digital accessibility and how to exercise them (66%). The primary theme identified in participants’ comments was that they wish to learn about the options available to them from the wealth of different digital accessibility tools available nowadays and to learn how to get the most out of the tools that would be of most benefit to them. Many participants would like training tailored to supporting them with their studies, as well as with jobs and life in general. The ideal training course was described as accessible and easy to understand.

## 5.2 Interview findings

Several main findings have been identified from the analysis of the interview data. The first key finding is that, in line with the questionnaire results, interviewees underscored significant gaps in the availability of digital accessibility training, and the urgent need for and benefits of providing better training for all. The second finding was that experiences of gaps in provision start early, with interviewees having faced a lack of technical support and specialist knowledge at school. Thirdly, while somewhat better support and training were encountered at university, interviewees reported that they were introduced to an overwhelming number of tools all at once, and as was found in the questionnaire results, sessions were too few and too short. Moreover, an uneven provision of digital accessibility training across the country

was highlighted, as were interviewees’ experiences of learning about digital accessibility by trial and error rather than via formal training. Interviewees pointed to the need for more personalised training provided by trainers with specialised knowledge and for organisations to reach out to users to raise awareness more effectively of the training and support they provide. Interview findings are presented in more detail as follows in this section.

A view strongly expressed by several interview participants is that there is currently a significant lack of available training in digital accessibility and that it is crucial to raise awareness of the importance of digital accessibility and to improve the provision of training for everyone, especially now that digital technologies are such an integral part of people’s lives. As one interviewee put it: “...not everybody comes in the world in the same mould. [...] So as especially now we’re becoming so much more digitally focused. To make sure that everybody can go along in that journey as well.” One interviewee felt that better digital accessibility training for all would reduce discrimination and ignorance and would foster greater inclusion and acceptance. Another pointed out that a large proportion of the population is being excluded if digital accessibility is not being taken seriously, and said: “I think there’s a big lack in training in this field. I think it should be a necessary component of many fields of study.” One interviewee also stressed the importance of accessible and effective training on how to use digital accessibility tools which are key to work and study, as people’s livelihoods and careers can depend on this, including people with dependents.

Interviewees also spoke about their experiences of receiving digital accessibility training at school, in further education or HE settings, and/or as part of a government scheme to support disabled workers. While a few interviewees commented that they had received good support at school, especially those who learned braille and touch typing, several

them with their studies [36].



pointed out that there had been a lack of technological equipment and specialised knowledge at their schools. One interviewee reported that no accessibility tools were offered at their school even though they were recommended to them at hospital visits, and another remarked that, although their teachers tried their best, the interviewee's progress was slowed by the teachers' lack of knowledge of how to use the accessibility tools. Several interviewees said that schools should be equipped to provide pupils with better training in the different ways to use more up-to-date and advanced accessibility technologies to support their learning, such as screen readers and speech to text tools, before they go on to further or higher education or the world of work.

When it comes to applying for DSA, interviewees who sought this support over 10 years ago reported receiving very effective provision, with plenty of equipment and training over a number of sessions. In contrast, those who have received DSA in recent years said that their experiences left a lot to be desired. They commented that they were simply provided with a lot of tools, with very little training on how to use them, and one reported that she received her training and technology late. One noted that "there just wasn't enough time. And there was a lot of content to [...] think about" and another said "I never got training on all of my tools. They just gave me a laptop with all this stuff on."

Some interviewees felt that accessibility support and training was somewhat better at university. However, several pointed out that they were not made aware of the support that was available to them, and that as a result they did not know it existed or what to ask for. Several interviewees commented that no support or training was offered to them, with one pointing out that accessibility was not included in welcome week activities at their university and noting that "there's never any emphasis or anything for students with disabilities". Interviewees felt that accessibility support at university should be advertised more explicitly, with better communication between different departments, and that university websites, libraries, eBooks and other learning materials should be more accessible.

Moreover, as was the case with DSA training, and in line with the questionnaire results, interviewees reported that the training sessions they received at university were too short to support them effectively in learning to use the plethora of accessibility tools on offer to help them with their studies, and that as a result they had felt overwhelmed. One interviewee pointed out: "it's just too quick and you can't really get your head around it. Especially if you're just starting uni", and another commented: "the training wasn't that useful, because I got overloaded with information". They were strongly of the view that longer training courses would be beneficial, with more time spent on each piece of software during the sessions, and more time built in between each

session to enable students to implement the knowledge gained and practice using the tools, incorporating them into their learning. One interviewee commented that ongoing training during the semester would better support students, beyond the sessions they were offered in welcome week, which could also be offered online. Another said that they had received good support for their studies but did not feel prepared for the world of work: "I know how to manage my dyslexia a lot better at university [...] But I am not sure how I will cope with my dyslexia when I'm in full time work." They remarked that students would benefit from the provision of workshops on using digital accessibility tools in the workplace, to prepare them for their future careers.

In terms of employment-related support, interviewees' comments on the UK government scheme Access to Work<sup>8</sup> and on the training provided by user associations and charities were positive. However, as regards digital accessibility training available outside of the formal education system more generally, several interviewees were strongly of the view that, in addition to the urgent need to improve the provision of training as discussed at the beginning of this section, there is also a disconnect between the support that is currently available and users reaching out to access that support. Interviewees felt that many users do not ask for support because they are not aware it exists and/or do not know how to access it, and they stressed that more needs to be done to raise public awareness of the training currently on offer and of how to access and use it. Moreover, interviewees commented that many users are unaware of the range and functions of accessibility tools that are readily available or come built into digital devices for consumer use nowadays, and commented that if the public in general knew about them, they would make more use of them, in a variety of ways. One interviewee noted:

I don't think there's enough out there really to make people aware that these things exist. [...] I think if these accessibility tools were more out there, and advertised more, more marketed, I think people would use them. [...] And what's beautiful is that they are built into mainstream devices, there's no extra cost or extra configuration that needs to be done. It's just there and readily available, if people knew about it.

One interviewee underscored how important it had been for them to tackle this by reaching out to user associations and making connections with others, and another was of the view that the provision of video tutorials on the basics of digital accessibility would be useful as training resources for users.

<sup>8</sup> Access to Work is a UK government grant scheme which supports people with a disability or health condition with work [37].

In line with the questionnaire findings, several interviewees commented that their experience of learning about digital accessibility had been one of trial and error, and even of “discovering many things just by accident” rather than of receiving coherent, formal training, and that it had required them to be proactive and seek out information independently. Some expressed that they felt “lucky” or “fortunate” that they had happened to encounter good support, and that many users rely on the goodwill of friends and contacts to provide informal training, rather than being able to access organised training. Another issue raised by interviewees is that of the patchy provision of training and support across the UK. Interviewees pointed out that digital accessibility support services may be based miles away from some users, which one interviewee who works for a user association commented “can be a bit of a postcode lottery at times, which is very disappointing” and is “a pretty difficult, awful situation”.

In the face of these gaps, interviewees gave several recommendations to improve digital accessibility training. One key theme identified in their recommendations was the need for more personalised training provided by trainers with specialised knowledge. Many interviewees had experienced real challenges in finding tailored support from trainers with advanced knowledge of the increasingly sophisticated technologies available today, and strongly felt that they and other users would benefit from an increased availability of one-to-one training with specialist trainers who can respond to their particular needs. Other recommendations include ensuring flexibility in training, implementing buddy schemes and integrating digital accessibility training into deaf and disability awareness courses.

## 6 Discussion

The current study set out to examine the practices, views and experiences of users with disabilities regarding digital devices, accessibility tools and training in the UK. Another goal was to assess participants’ views on how digital accessibility training could be improved and on what types of training users would benefit from. The finding from the questionnaire data that users with disabilities are making regular use of a wide range of digital devices and accessibility tools is reflective of the digital era we are living in and of recent advancements in digital accessibility as underscored by Brown and Hollier [18] and discussed in Sect. 3. It confirms that such users are participating in the digital age alongside other members of society and throws into sharp relief the fundamental importance of ensuring that users with disabilities have access to effective digital accessibility

training and support, an imperative that has been underscored by participants in the present study.

However, a major finding from both the questionnaire and interview data is that there is currently a paucity of digital accessibility training, and as such, the present study contributes evidence of a digital accessibility training gap which is a significant factor reinforcing the digital divide experienced by people with disabilities and a form of social oppression and exclusion as explained by the social model of disability [4]. It is also consistent with the work of Chadwick and Wesson [17] (see Sect. 3), which has moreover highlighted that people with disabilities have much to gain from having full and equal access to the digital world, as it would assist in breaking down disabling barriers and reducing digital exclusion. Furthermore, the finding that several interviewees strongly felt there is a gap between the digital accessibility training and support available and users’ awareness thereof points to the need for better access to access, as emphasised by Fryer [38], to remove this knowledge barrier for users with disabilities, and therefore for such organisations to reach out to users more effectively and provide accessible information on the support and training they offer.

A key finding from the interviews is that deficiencies in digital accessibility training and support appeared early on in participants’ educational trajectories, with many having experienced a dearth of up-to-date technology provision and specialist knowledge at school. This finding is in accord with the research carried out by the UK Department for Education itself, which has identified assistive technology<sup>9</sup> as an “under-utilised intervention to provide pupils and students with special needs and disabilities a means for accessing and engaging in the curriculum in ways that are representative of the ubiquitous nature of technology in society” [40]. Moreover, in the Education Technology (EdTech) Survey 2020-21 [41], over half of primary and secondary schools in England state that the education technology they use to support pupils with SEND does not sufficiently meet their needs. With over 1.5 million (17.3%) pupils in schools in England recorded as having special educational needs and disabilities (SEND) [42] and pupils having much to gain from more inclusive educational environments, it is evident that greater efforts are needed to improve the provision and implementation of assistive technology in schools, and as

<sup>9</sup> While for the purposes of the current study the broader term ‘(digital) accessibility tools’ has been adopted, in the literature on educational technology and thus in these lines, the term ‘assistive technology’ is employed, which can be defined as “...any item, piece of equipment or product system whether acquired off the shelf, modified or customised that is used to increase, maintain or improve the functional capabilities of children with disabilities.” (Sect. 3, Individuals with Disabilities Education Act, 2004 [39]).

is underscored by Edyburn [40], much more research is needed in this area.

In the EdTech Survey 2020-21 [41], teachers identified supporting pupils with SEND as a key priority for future investment in education technology, and recommended a review of digital technologies used to support pupils with SEND and developing guidance on the use of accessibility features built into mainstream devices and software, highlighting that the latter would be of particular benefit to primary schools. Edyburn [40] points out that realising the potential of AT in schools will require the combined efforts of relevant stakeholders, including pupils, parents, educators, policymakers, researchers. etc., and that achieving this aim will have academic, behavioural, social and economic benefits for pupils with disabilities. Participants in the current study recommended that digital accessibility be taught to all children throughout their educational journey, in accord with the universalist account of accessibility set out in Sect. 2.

In terms of the HE context, numbers of students with disabilities have been steadily increasing since the turn of the century, in the UK, where in 2020/21 15.2% of students disclosed as disabled [43], and in Canada, the USA and several other countries [44]. However, students with disabilities remain underrepresented in HE, are among those most at risk of withdrawing from university [45] and tend to have lower degree results than non-disabled students [46]. Moreover, employment outcomes are worse for students with disabilities: the Advance HE 2022 report on equality in HE [43] found that proportionally more students with disabilities who qualified in 2019/20 in the UK were unemployed than their non-disabled peers, and a smaller proportion were employed in full-time work. This inequality in employment outcomes points to the need for HEIs to better prepare students with disabilities for future employment, including using digital technologies in the workplace. Indeed, as reported in Sect. 5, an interviewee felt their HE experiences had not prepared them for the world of work and recommended the provision of workshops for students on using digital accessibility tools in employment settings to prepare them for their future careers.

One factor which could well be contributing to these poorer outcomes is the numerous challenges that students with disabilities report facing at university [44]. Seale, et al. [44] note that students with disabilities often “feel they have to work harder than other students because they have to manage both their disability and their study” and that the need to learn new and complex technologies can add to the pressure. They also point out that “[m]any disabled students can only access learning resources and engage with learning experiences if they have access to assistive technologies” and as a result can find themselves disadvantaged

by inadequate access to AT. Given that the effective use of technology “can remove barriers to equitable education for disabled students and [...] promote inclusion of disabled students in HE” [44], a lack of accessibility in HE places students with disabilities on the “wrong side of a second digital divide” [47].

Indeed, while some interviewees in the current study reported more positive experiences of accessibility support and training in HE contexts than in schools, several deficiencies and challenges were also highlighted, which corroborate the view that students with disabilities face such a digital divide. For example, Seale et al. [44] note that many students with disabilities are offered AT training right at the beginning of their studies only, at the same time as they are coping with settling into a new life and course at university. They conclude that it is unsurprising that several students in their study reported being “overwhelmed” due to the “front-loaded” nature of the training offered, since they have little say on the timing, speed or content, and as they “tend to be treated as empty vessels that need filling with information about how to use AT” [44]. Moreover, a report produced for the Department for Education [36] found that most disabled student participants (62%) would prefer to meet with learning support staff more regularly. These results mirror those of the current study, in which participants reported that training sessions were too few and too brief to learn how to use the profusion of AT offered, causing them to feel overloaded with information, particularly if they were “just starting uni” (see Sect. 5). They strongly felt they would have benefitted from ongoing training during their course, not just in welcome week.

In terms of DSA support, Johnson et al. [36] give a positive evaluation overall, stating that students who receive DSA support are generally satisfied with it, and that it broadly meets their needs. These findings contradict those of the current study, in which participants who had accessed DSA in recent years commented negatively on their experiences. However, it could be argued that the results of Johnson et al. [36] are rather more mixed than they appear. Only just over half (55%) of respondents agreed that the support meets all their needs, and 28% disagreed. Moreover, just over a third (35%) said there were still gaps in the study support they needed. In addition, participants gave mixed feedback on the training received on using IT equipment and specialist software. While some training was evaluated positively, some trainers were “unhelpful, lacking in specialist knowledge, and not understanding of the student’s needs” [36]. One student reported that they were not provided with any training and were just given the equipment and left to “get on with it” themselves [36]. This was also the experience of a participant in the current study, as discussed in Sect. 5. Additionally, participants in both the Johnson et al.

report and an interviewee in the current study faced delays in receiving training and IT equipment.

Furthermore, a key issue identified by Johnson, et al. [36], is that many prospective students are unaware of the support available, since only two in five (40%) had heard of DSAs before starting their course. This finding chimes with those of the current study, where several participants reported that they had not been made aware of the support available in HE contexts, and that they therefore did not know it existed or what to ask for. They recommended that the existence of such accessibility support and training be communicated more effectively (see Sect. 5). As discussed earlier in the current section, the need for better access to access [38] has been identified as an imperative beyond HE contexts too. The present study also found that participants who had received DSAs in recent years commented much more negatively about their experiences of that support than those who had received DSAs over 10 years ago. This result reflects those of Johnson, et al. [36], who found that satisfaction with DSA-funded IT equipment and specialist software was higher among students who first received DSAs prior to the changes in 2015/16<sup>10</sup> than among those who first received DSAs from 2016/17 onwards.

## 7 Training

The DA4You project created digital accessibility training to contribute to filling the gaps identified, designed in accordance with the social model of accessibility and the three shifts identified by Greco [3, 6] (see Sect. 2). The design of the training was also informed by the findings of Seale et al. [44]: we agreed that current AT training too often positions learners in an overly passive role, and we aimed for our training to empower learners to be active IT users and to be able to make informed decisions about how they engage with technology. The learning objectives of the training were for participants to: (1) become aware of accessibility legislation and how to exercise their rights as users; (2) learn about and explore built-in digital accessibility features of devices; (3) discover a range of digital accessibility apps; and (4) put their knowledge of digital accessibility features into practice by means of practical activities and tasks.

A total of 37 participants aged 18–51 with a range of disabilities took part in the training; 35% were blind or partially sighted, 30% were autistic or had Asperger syndrome, 30% were dyslexic, 19% had ADHD, 11% had dyspraxia, dysgraphia or dyscalculia and 11% were deaf or hard of hearing. The training was held face-to-face and remotely.

<sup>10</sup> Significant changes were made to DSAs in 2015/16 which included cuts to the funding and IT equipment provided, and greater responsibility was placed on HEIs for supporting disabled students [45].

Face-to-face sessions took place in February 2020 at the University of East Anglia and were led by two lecturers and supported by two student volunteers. These sessions consisted of nine hours divided into three 3-hour sessions. The remote sessions were held in November 2020 via Zoom and consisted of seven hours and thirty minutes divided into five 90-minute sessions. The sessions were interpreted by British Sign Language interpreters and live subtitling was provided by a professional respeaker.

In the first part of the training, participants identified and discussed key concepts and legislation linked to accessibility, such as universal design<sup>11</sup> and the CRPD. Then they researched and explored built-in accessibility features and apps used on smartphones, tablets and PCs on the three most popular operating systems - Android, iOS and Windows - and presented the tools to their group. In the next session, participants researched and discussed accessibility and social media. They then put their new knowledge into practice by creating accessible social media content on the topic of digital accessibility and were encouraged to include images with alternative text and subtitled videos. In the following part of the training, participants became familiar with the features and uses of a range of accessibility tools for subtitling, audio description, speech-to-text, text-to-speech, screen reading, screen magnification, and electronic/digital braille. After trialing the tools, participants evaluated and discussed which accessibility tools could be most useful for own their personal life, work or studies, and for people with different disabilities according to specific hypothetical scenarios presented.

After the training, 31 participants completed a feedback questionnaire, the results of which are presented as follows.

Participants were asked to indicate the extent to which they agreed with a series of statements on a 5-point Likert scale. Table 2 presents the quantitative results in percentages. It can be observed that their feedback is very positive overall. Almost all participants agreed or strongly agreed with nearly all the positive statements presented about the training. Responses about the trainers and activities were particularly positive, with a large majority of participants strongly agreeing that the trainers encouraged participation and interaction and that the activities have helped them to learn about digital accessibility.

Participants were also invited to provide qualitative feedback in the form of comments. When asked what they liked best about the training sessions, participants especially

<sup>11</sup> An example of the universalist approach to access implemented in the training (see Sect. 2). Universal design is understood here and in the training as the “design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialised design” [48]. However, this does not exclude the use of assistive technologies.

**Table 2** Quantitative participant feedback on digital accessibility training

Statements	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
This training is well prepared and well organised	68%	29%	3%	0%	0%
This training has been useful for me	63%	31%	6%	0%	0%
This training has helped me feel more confident about using digital accessibility tools	29%	65%	6%	0%	0%
The training materials are clear, helpful and accessible	49%	45%	6%	0%	0%
The training activities have helped me to learn about digital accessibility	74%	26%	0%	0%	0%
Every stage and element of the training course has been fully accessible to me	65%	32%	3%	0%	0%
The length of the training was about right	60%	30%	10%	0%	0%
The trainers encouraged participation and interaction	84%	16%	0%	0%	0%
The trainers offered sufficient advice and support	74%	23%	3%	0%	0%
Overall I am satisfied with the quality of this training	68%	29%	3%	0%	0%
I would like to learn more about digital accessibility	45%	26%	29%	0%	0%

appreciated the supportive and welcoming atmosphere. They also particularly valued meeting and exchanging ideas with other participants, learning from their ideas and being in a group that shared the same enthusiasm for accessibility. Participants enjoyed learning about a wide range of tools and apps on different operating systems. One pointed out the “thorough and active introduction to accessibility tools”, appreciated the step-by-step approach to learning and valued the variety of options to use an Android or Apple tablet or PC. They also valued the flexible approach, responding to participants’ feedback and needs. Another participant explained that the training sessions were set at a good pace and covered a great deal around digital accessibility, bringing together different methods of making digital content accessible. They found it helpful to hear about other people’s experiences and the technologies they found useful. As a consequence, the training gave them a greater awareness of the challenges that people with different disabilities face as IT users.

When participants were asked about what they would have like to be done differently, one main concern was to do with the length of the sessions, as reflected in the quantitative responses above. This feedback informed our decision to make the remote sessions shorter. Also regarding the remote sessions, a participant mentioned that they found difficult to navigate in the breakout rooms and use the handouts. As a screen reader user, they found it difficult when participants used the chat to interact during breakout rooms. Therefore, a suggestion was made to designate a person who could read out content in the breakout rooms. Participants had been asked in the main sessions not to use the chat except when invited to for this reason, and it is helpful to note from this feedback that the use of the chat should be managed or avoided in breakroom rooms also. Moreover, it was acknowledged that running online training is more

challenging than face-to-face, and the online sessions were adapted well.

## 8 Conclusion

This study has contributed new empirical evidence on a critical topic that has thus far been under-researched: the practices, views and experiences of users with different disabilities regarding digital accessibility tools and training. The findings confirm that while users with disabilities are co-participants in the digital world together with other members of society and use a wide variety of technologies and accessibility tools, training in digital accessibility is currently lacking. The considerable training gaps and challenges faced by users with disabilities from their early years onwards, including at school, university and in their adult lives, reinforce the digital divide they experience. The digital accessibility training created by the DA4You project aimed to contribute to filling these gaps and to empowering learners with disabilities to be active IT users who can make informed decisions about how they can make use of accessibility tools to benefit more fully from their use of digital technologies. The training received very positive feedback from participants overall, with a large majority (71%) indicating that they would like to learn more about digital accessibility. Questionnaire results also clearly showed that users with disabilities are keen to be able to access more and better accessibility training.

The findings of the current study confirm that much more needs to be done to provide users with disabilities with more effective digital accessibility training to enable them to participate fully as digital citizens, and it is incumbent upon educators, administrators and policymakers, etc., to tackle this as a priority. Participants also provide several insights and recommendations to be taken into account by providers

of digital accessibility training and support. Further research is needed to better understand the needs of learners and develop effective digital accessibility training for different contexts, such as in schools, further and higher education, workplaces and user associations.

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**Author contributions** Conception and design of the study, as well as material preparation, data collection and analysis were performed by S.B. Also, S.B wrote Sects. 1–6 and 8 of the main manuscript text and prepared Figs. 1, 2, 3 and 4; Table 1. C.D.P.O wrote Sect. 7 of the manuscript text and prepared Table 2. Both authors reviewed and approved the final manuscript.

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**Data availability** Data will be made available upon request to the corresponding author.

## Declarations

**Human Ethics and Consent to participate** This research was reviewed and approved by the General Research Ethics Committee (GREC) of the University of East Anglia, UK on 18 June 2019. The University of East Anglia's core principles for ethical research are in line with the Economic and Social Research Council's (ESRC) *Framework for Research Ethics* [34]. Participants were provided with an Information Sheet about the research and signed an Informed Participant Consent form to confirm they agreed to take part in the study.

**Competing interests** The authors declare no competing interests.

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