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Digital participation and digital education for people with profound and multiple disabilities and complex communication needs

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"Digitalisation" is the buzzword of many societal as well as social changes. Participation in society is increasingly realized digitally, which is why it is important to be involved in these processes and to participate in the digital world. The UN CRPD also assigns an important role to (digital) technology as a prerequisite for inclusion and participation. Universal design, accessibility, assistive technology, and reasonable accommodation should help to avoid exclusion for people with disabilities. People with profound intellectual and multiple disabilities (PIMD), who often have complex communication needs (CCN) in addition to severe cognitive impairments, have fundamentally limited opportunities for participation. These are also visible in the context of digitalisation. At the same time, digital media also offer specific opportunities, particularly for people with PIMD and CCN. Among other things through the combined use of assistive technologies, digital media can significantly facilitate their daily lives. The present paper examines the significance, requirements and challenges as well as the potentials of digital participation and digital education in the lives of adults with PIMD and CCN and presents considerations for the design of digital education for adults. Finally, a conceptual framework for digital education for people with PIMD is presented.

KEYWORDS

digital participation, people with complex communicational needs (CCN), digital literacy, digital education, augmentative and alternative communication (AAC), people with profound intellectual and multiple disabilities (PIMD)

1. Introduction

"The term digital participation refers to the active involvement in digital society through the use of modern information and communication technology (ICT), such as the Internet" (Seifert and Rössel, 2019). In the everyday lives of people without disabilities, there is a tendency toward a fully digitalised living environment in which abstaining from digital technologies becomes increasingly challenging (Moser, 2019), as everyday tasks such as booking doctor's appointments, carrying out banking transactions, buying train tickets but also social communication and participation are becoming progressively carried out online or through digital media. The associated current development is thus a societal process, "in

which digital media and digital tools are increasingly taking the place of analog processes and not only replacing them, but also opening up new perspectives in all social, economic and scientific areas, but also bringing with them new questions [...]" as the German Standing Conference [Kultusministerkonferenz (KMK), 2017, own translation] of the Ministers of Education and Cultural Affairs pointed out in a strategy paper.

In this context, digital media have a cross-sectional function that ensures the right to comprehensive participation and digital inclusion for all citizens and thus equally for persons with disabilities. The United Nations Convention on the Rights of Persons with Disabilities (UN-CRPD) also contains many references to the right to use media, e.g., Art. 8 (awareness raising), Art. 9 (accessibility), Art. 21 (access to information), Art. 24 (education), Art. 29 and 30 (participation in political, public and cultural life). These legal claims can be met by expanding digital participation opportunities through barrier-free access, which according to Zorn et al. (2012) can be seen in terms of "[...] technical usability, perceptibility with different senses, as well as the comprehensibility of the language and simplicity of the user guidance" (own translation). In addition to the requirements regarding access and accessibility, digital participation for people with disabilities also involves further considerations according to Bosse (2014):

- Participation in media, i.e., how accessible are modern media?
- Participation in the media, i.e., how are people with disabilities portrayed in media and how frequently are they represented?
- Participation through media, e.g., in the form of competent use of modern technologies and media.

So when talking about digital participation, it is necessary to consider a variety of aspects that can influence it. These include, for example, access possibilities, functionalities, support needs, etc. In order to be able to take individual participation needs into account in addition to necessary structural measures, expanded possibilities are needed, which can be realized above all through educational and empowering offerings, because "in a mediatised society, education with, about and through media is fundamental for social belonging and participation" (Zorn et al., 2012, own translation). Digital education thus contributes to participation and equal opportunities and is therefore an overriding and important component of digital participation. For people with profound intellectual and multiple disabilities (PIMD) and complex communication needs (CCN), this presents special challenges, as these people acquire their surrounding world primarily through basal-perceptive and active approaches, which are still (too) little considered in digital and even educational contexts, which is why this article attempts to meet both requirements and explicitly develop possibilities for this group of people. After giving a brief description of the living conditions of people with PIMD and CCN, we will outline the state of research and describe the advantages, barriers and potentials of digital technologies for these people before outlining conceptual considerations.

2. Digital participation of people with intellectual disabilities and profound intellectual and multiple disabilities

2.1. Advantages and disadvantages of digital media for people with ID and PIMD

People with PIMD are an extremely heterogeneous group that is not clearly defined in the international discourse. Instead, there are different attempts to describe the persons.

Dins and Keeley (2022) summarize: "Most descriptions of this group of persons refer to medical classifications." The latest and 11th revision of the International Statistical Classification of Diseases and Related Health Problems (ICD-11) include the following key characteristics: "A profound disorder of intellectual development is a condition (…) characterized by significantly below average intellectual functioning and adaptive behavior that are approximately four or more standard deviations below the mean."

Thus, the group of persons with PIMD consists of people with a profound intellectual disability (ID) in combination with severe motor disabilities (Nakken and Vlaskamp, 2007). Additionally, they commonly experience severe communication disabilities, sensory disabilities, and they often have complex health needs (Doukas et al., 2017). This is also in line with the definition of the group given by the International Association for the Scientific Study of Intellectual and Developmental Disabilities (IASSIDD), which describes these individuals as "a heterogeneous group. They are characterized by very severe cognitive, neuromotor and/or sensory disabilities, which lead to very intensive support needs" Bernasconi (2007). These support needs manifest across all domains of daily life, so that a common characteristic of this group of people is that they "typically require daily support in a supervised environment for adequate care" (Dins and Keeley, 2022).

All of these various congenital conditions (e.g., autism, cerebral palsy) in addition to acquired disabilities (e.g., amyotrophic lateral sclerosis, stroke) and contextual factors (e.g., lack of augmentative and alternative communication (AAC) tools or lack of expertise in their use) lead to complex communication needs: "People with PIMD experience extensive problems in communication. Language is limited or non-existent and communication may include very subtle cues including physiological signals such as a rise in body temperature or change in level of alertness" (Wessels and van der Putten, 2017). This poses particular challenges for support, because "due to the fact that these signals are highly individual, the number of those interaction partners who are actually capable of understanding and appropriately reacting to these signals is very restricted" (Engelhardt et al., 2020). Thus, in all considerations on the design of participation opportunities, a person-centered approach must be taken into account, which carefully considers the communicative and cognitive abilities of each individual with PIMD. It is particularly significant to regard communication and interaction as an ongoing, responsive process. To facilitate the realization of full and effective participation of people with PIMD, it is imperative to consider not only their individual communication needs but also to ensure that their supportive environment adopt a responsive and interactive stance toward these needs.

Therefore, it can be stated that successful and functional communication capabilities represent a key to participation in all social and societal areas, which is particularly evident in the context of digitalisation, since digital media are primarily communication media. Bosse et al. (2020) state, that people with CNN face additional barriers that prevent them from using the Internet and social media more extensively. Consequently, Kleinert (2020) states that if there is no possibility of communication with, via and in digital media, exclusion and disadvantage are often the result.

Findings on the use of digital media and on the possibilities of digital participation of people with (intellectual) disabilities are currently still a desideratum, even though there is an increase in studies that also take this group of people into account (Caton et al., 2022). Basically, it can be stated that "existing surveys examining Internet access and use often exclude persons with intellectual disabilities due to questions not being cognitively adapted. Therefore, knowledge about access to and use of the Internet comparing adolescents with intellectual disabilities with young people without intellectual disabilities is limited (Chadwick et al., 2013, 2017; Alfredsson Ågren et al., 2020).

The studies that also consider the group of adults with ID highlight potential benefits as well as risks. For instance, Chadwick et al. (2013) found in their study that older people and people with cognitive, physical or sensory impairments in particular experienced difficulties in using digital media or the internet. Alfredsson Ågren et al. (2020) conducted a comparative study between young people with and without disabilities and concluded that internet use differs significantly between the two groups: "The results reveal that a significantly lower proportion of the 114 participating adolescents with intellectual disabilities had access to internet-enabled devices and performed internet activities, except for playing games, than the reference group ($n = 1,161$)."

Advantages are highlighted in terms of personality development through self-expression and self-awareness (Steinfield et al., 2008; Caton and Chapman, 2016). Furthermore, opportunities for expanding social contacts and interactions are seen. Löfgren-Mårtenson (2008) describes the social internet as a new "free zone" for people with intellectual disabilities for socialization and personal development without constant control by caregivers.

These positive aspects are contrasted in other studies with aspects around the so-called digital divide (see below), which means that the potential benefits can often not be accessed at all due to structural difficulties (Chadwick et al., 2013). Caton and Chapman (2016) also confirm that although people with ID do have positive experiences with social media but generally have fewer opportunities to access them. A study examining the use of Facebook by individuals with intellectual disabilities identifies potential advantages, including interaction with others, self-presentation, expanding social networks, and equal participation. However, it also acknowledges the limited access opportunities both in terms of content and technology (Shpigelman and Gill, 2014).

In addition to the identification of positive aspects, there seems to be a tendency to regard people with ID as particularly vulnerable and in need of support in view of the potential risks. In this context, it should be questioned whether the risks associated with internet use apply exclusively to people with ID or whether they are not general risks in the use of social media or the internet? Accordingly, Borgström et al. (2019) also ask whether a protective approach to the internet might also become a barrier to access.

Seale (2014) discusses how potential risks can be reconciled with the simultaneous advantages of modern digital technologies and argues for an approach that also sees risks as positive potential for development. Accepting and dealing with risks can then ultimately lead to acquiring enhanced competences in digital media and gaining more control over one's own (digital) life. Therefore, the avoidance of risks should be considered secondary to the developmental potentials that arise in the use of social media by people with ID: "the potential benefits outweigh the potential harm" (Seale, 2014).

The increasing pervasion of everyday life by and through media reveals a division between people who participate in and through media and those who are unable to do so. In the context of internet use, this disparity is commonly referred to as a 'digital divide'. According to Norris (2001) this term refers to a multi-dimensional phenomenon that must be focussed on a global level (i.e., with regard to different countries and their respective access possibilities), on a democratic level (i.e., with regard to a population's opportunities for co-determination and information) and finally on a social level (i.e., on individual possibilities and preconditions for use). For people without access to digital media, this creates new risks of (digital) exclusion. This applies in particular to people with disabilities. These risks arise from a combination of structural preconditions, personal skills and technical conditions.

This is compounded by the fact that "cognitive disabilities are the least understood and least discussed type of disability among web developers. As a result, developers rarely design web content to be accessible to people with cognitive disabilities. This is unlikely to change overnight, because the amount of research related to the accessibility of web content is relatively scarce" (Bohman, 2004).

In addition to internet applications, the field of digital media also includes assistive technologies (AT). These are considered technical aids that are intended to compensate for physical and cognitive impairments for medical-rehabilitative purposes Schüller et al. (2021). Weed et al. (2011) distinguish various categories of assistive technologies, including augmentative and alternative communication (AAC), adapted computer access, devices to assist listening and seeing, environmental control and adapted play and recreation. Thus, there is a close connection between AT and AAC. Especially when combined, these possibilities also represent a significant contribution to compensating for communication and disability-related impairments for people with PIMD and CCN. Through their use, they can, for example, take over the function of speech if the spoken language abilities of an interlocutor are not sufficiently present. Due to their digital tools, digital media already have features that may at first sight not consider assistive technologies in the classical sense, but can be used to support their function, such as speech output or speech recognition (Schüller et al., 2021). Especially access to social media has many advantages for people with CCN, e.g., building and maintaining social relationships, reducing loneliness or opportunities for self-expression (Bosse et al., 2022). AAC media and tools tend to

be used as assistive devices from a medical perspective but can also be understood as significant media for communication and information from a media education perspective (Krstoski, 2016). Thus, it can already be stated that the use of tablets has facilitated communication opportunities that did not previously exist in this form. In this manner, these digital technologies are already making a valuable contribution to the inclusion and participation of people with PIMD and CCN. In addition, technological advancements enable participation in social media. Video calling, for example, or camera footage of personal experiences can be seen as a means of articulation. In the context of AAC support, experiences with video-assisted therapy have existed for over 10 years (Hall et al., 2019). So-called tele-AAC as a form of video-assisted therapy provides insights into individual possibilities of digital communication and participation in digital media. In particular, the "on-site facilitator" (Hall et al., 2019) required for tele-AAC can be seen as a possibility for personal participation support. Technical support is provided, such as ensuring the proper positioning of the camera, the (digital) device and the communication aid, while the supporting person can facilitate participation in specific situations or contexts (e.g., by individually responding to situational needs and requirements).

2.2. Barriers to the use of digital media

In addition, the increasing complexity of web applications also creates new barriers for users. For example, the almost infinite amount of information on the World Wide Web represents an easy and low-threshold way of accessing information, but at the same time, it requires individuals to process and utilize this wealth of information cognitively. Phenomena such as 'cognitive overload' or 'getting lost in hyperspace' (Bernasconi, 2007) describe possible difficulties that may arise. Moreover, technical requirements, such as the control of technical devices or reliable internet connections, are possible barriers contrary to the potential of the internet and the possibilities of modern technologies.

Berger et al. (2010) have classified the barriers that affect internet usage in multiple dimensions as follows: application-related barriers (resulting from the design of the application or the technology and/or coding which is used), disability-related barriers (arising from the negative interaction between user limitations and application requirements e.g., missing reading function for people with limited reading ability) and individual barriers (i.e., other aspects such as lack of technical equipment or prior knowledge and limited experience with web 2.0 applications).

More specifically related to the needs of people with ID, Lussier-Desrochers et al. (2017) identify five challenges: [1] access to digital devices, [2] sensorimotor, [3] cognitive and [4] technical requirements and [5] the comprehension of codes and conventions. These five dimensions interact with the person and the conditions of the environment and illustrate the synergy between individual resources and support from the environment.

Since people with ID and especially with PIMD are dependent on (professional) support, attention should also be directed toward the digital competencies of supporting professionals, as well as the institutional structures and services. For example,

Hoppestad (2013) was able to show that barriers to participation resulted from the fact that the people providing support did not have sufficient media skills. And Ramsten et al. (2017) demonstrated in their study a "lack of organizational support and comprehensive strategies for the use of Information and Communication Technologies (ICT) in municipal social care for people with intellectual disability."

In this context, Sachdeva et al. (2015) extend the above-mentioned term to the "digital disability divide," which refers to the additional exclusion of individuals with disabilities from the potentials of modern media, due to their often marginalized position in society, lack of economic or educational resources and competencies.

However, it is important to emphasize that while the mentioned studies provide valuable insights, they seldom consider the specific needs of people with PIMD and CCN. Consequently, there is a fundamental lack of knowledge about the possibilities of digital participation for this group of people, and there are only a few studies that put this group of people into perspective at all. Notably, Caton et al. (2022) conducted a study that examined the digital participation of people with profound disabilities during the COVID-19 pandemic in the UK. They conclude that "during the COVID-19 pandemic, there has been a worldwide increase in the use of digital technology. (…) However, the experiences of digital participation or nonparticipation for people with profound and multiple learning disabilities (PMLD) is less understood" (Caton et al., 2022). In this study, Caton et al. (2022) explicitly addressed the internet use of people with PIMD and conclude by identifying potential barriers: "The challenging technical requirements of getting online (Lussier-Desrochers et al., 2017) and the accessibility of websites (Williams and Hanson-Baldauf, 2010; Shpigelman and Gill, 2014) are particular barriers for people with complex needs."

The specific ways and possibilities of communication for people with PIMD increase the problem in two directions: first, adequate ways of communication often have to be explored, and second, they have to be adapted and adjusted to digital contexts. Hoppestad (2007) notes that negative attitudes toward the use of digital media can also significantly limit available opportunities. Copley and Ziviani (2004) also conclude that major barriers include lack of appropriate staff training, negative staff attitudes or difficulties procuring and managing equipment. Furthermore, people with PIMD typically also require personalized access to educational topics that correspond to their learning capabilities. Because they "often have specific sensory and other challenges they need multisensory approaches to communication. The importance of touch for communication (Elliott-Graves, 2021) can suggest that digital connections may not be ideal for people with profound and multiple learning disabilities" (Caton et al., 2022). It is crucial to remain attentive to these exclusionary tendencies and respond with constructive developments and accessible solutions. As Weed et al. (2011) say, "for many individuals with disabilities, however, technology may not be the only solution. Rather, the combination of aided (e.g., mechanical, electronic, and computerized devices) and unaided (i.e., using the body or a body part alone) approaches with high- and low-technology strategies, is essential to provide maximum accommodation."

FIGURE 1
Continuum of digital participation and education (own illustration).
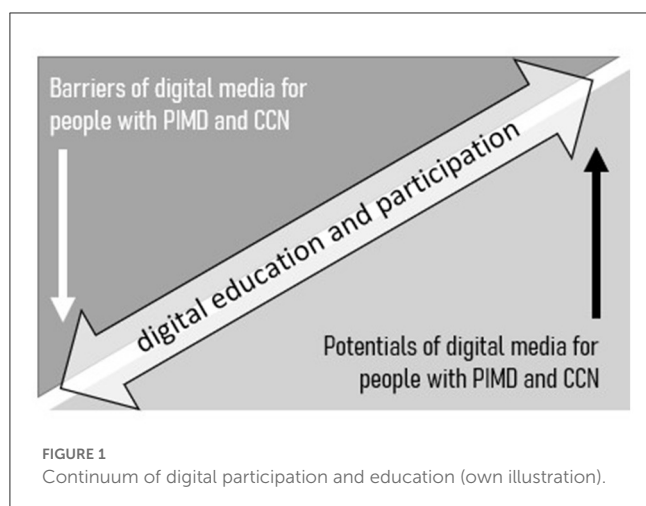
3. Summary: potentials of digital media in supporting people with PIMD and CCN

People with PIMD and CCN may benefit from the basic technical characteristics inherent to digital media. Two of the most significant characteristics that should be mentioned here are multimodality and multimediality (Miesenberger et al., 2012). The last enables content to be offered or made accessible equally via different channels, e.g., visual, auditive, haptic, etc. In this way, variants or alternatives can be provided that take into account the respective individual approaches or make the content perceivable in different ways. Multimodality refers additionally to the possible devices, media and tools, i.e., the different possibilities to support technical or digital interaction. This allows, for example, a comprehensive flexibilization and adaptation to the abilities and skills of the users.

The reciprocity between compensating possibilities and simultaneously occurring barriers can be described as a space of possibilities of digital participation. This refers to a spectrum in which challenges and potentials coexist. For example, digital media offer possibilities for both synchronous and asynchronous communication through AT and AAC. At the same time, digital (educational) settings must be designed in such a way that they do not generate new barriers through technical, content-related, or structural aspects.

Digital education through, with and by digital media for people with PIMD and CCN cannot be described as an either/or-situation or as a fixed goal, but rather as an ongoing process in which possibilities and limitations are always defined in relation to technical, content-related and ultimately structural conditional factors. These factors can either act as potential or as barriers, directly influencing the extent of individual digital participation.

The level of digital media acting as barriers directly correlates with limited opportunities for participation, whereas drawing on their potentials corresponds to increased possibilities for individual participation among individuals with PIMD and CCN (see Figure 1).

This means that the more individual aspects act as barriers (descending arrow), the less the advantages of digital technology can be used (ascending arrow). Accordingly, the continuum of digital participation results from the advantages and barriers of the individual life situation. In order to face the barriers and to be able to use the potentials of digital media, i.e., to enable digital participation for people with ID and PIMD, support is needed in terms of enabling and facilitating (digital) participation, which is why educational opportunities, also beyond school contexts, are of utmost importance in this area.

4. (Lifelong) education for people with PIMD

The right to education is a central human right, which was further specified and strengthened in its importance for enabling participation with the ratification of the UN CRPD. Article 24 in particular emphasizes the right to lifelong education, which applies to all people. In the context of schooling (with the following explanations referring to the implementation in Germany), this right is upheld. Children and adolescents with ID and PIMD have the right and the possibility of formal education within specialized educational institutions (special schools) as well as in the context of inclusive education. The same should apply to the post-school sector. However, a significant gap can be identified here, especially for people with PIMD. This gap exists not only regarding general aspects of education but also becomes particularly evident in the context of digital education (Bosse and Haage, 2020; Bernasconi and Keeley, 2021; Bernasconi, 2022). Specifically for the field of digital education, it can be said that it takes place primarily in school settings (Keeley et al., 2022; Heitplatz, 2023) and that extracurricular and post-school settings are only marginally taken into account.

Education understood as a possibility for (self-)empowerment initiated by educational processes (Sjöström and Eilks, 2020) enables individuals to subjectively engage with the world, thus realizing their participation in it. Education occurs through interaction with others and the encountering of different experiences and perspectives, meaning that education takes place through social and cultural participation. Accordingly, education is an indispensable prerequisite of participation and participation is the indispensable prerequisite of education (Keeley, 2018).

People with PIMD often require lifelong support and individualized educational opportunities to be able to actively engage with the world and to participate in education. People with PIMD acquire knowledge and skills primarily through active engagement with objects or through educational settings that address multiple sensorial modalities (Forster, 2010; van der Putten et al., 2011; Bottcher, 2012; Dins and Keeley, 2022). In the context of digital education, this raises implementation challenges, as digital environments generally provide limited opportunities for tactile or other more basal sensorial experiences. Besides, active manipulation is rarely possible. Digital education for people with PIMD therefore needs to address these specific challenges and start from there to foster digital participation.

FIGURE 2
Elements of the Digital Literacy Framework (Special Education Support Service, 2014, own representation).

5. Conceptual considerations on digital literacy for people with PIMD and CCN

Based on these considerations on the (lifelong) education of people with PIMD and CCN, there are also necessary requirements or constituent aspects for the field of digital education that should be taken into account when designing digital education offers. In the following, the question of digital literacy of and for people with PIMD and CCN will first be addressed, and then, in a second step, the so-called 4 As will be presented. These are conceptual principles developed by the Committee on Economic, Social and Cultural Rights (CESCR, 1999) as a basis for creating globally valid key elements for the implementation of the rights to education. From the consolidation of these two perspectives, a new conceptual framework is then constituted in a third step, from which criteria for the design of offers of digital adult education for people PIMD (and CCN) can be derived.

5.1. Digital literacy

Digital education as "teaching digital competencies in the sense of enabling people to reflectively use and engage with digital media with the objectives of digital self-determination and autonomy" (Keeley et al., 2021, own translation) requires

the use of digital media and the development of corresponding digital competencies. These are also referred to as digital literacy. The UNESCO Institute for Statistics (2018) defines it as follows: "Digital literacy is the ability to access, manage, understand, integrate, communicate, evaluate and create information safely and appropriately through digital technologies for employment, decent jobs and entrepreneurship. It includes competences that are variously referred to as computer literacy, ICT literacy, information literacy and media literacy." This definition focuses primarily on skills that are intended to enable participation in working life and thus only captures a fraction of the significance of digital competencies when considering that they serve as the foundation for digital inclusion across all societal domains. For this paper, we therefore follow the definition of the Irish Special Education Support Service (Special Education Support Service, 2014), which understands digital literacy as "the creation, communication and interpretation of meaning through multimodal digital formats, leading to fuller participation." This broad understanding of digital literacy also explicitly includes people with PIMD and CCN and provides starting points for the design of digital educational settings for this group of persons. To this end, SESS developed the "Digital Literacy Framework" (see Figure 2), which is primarily intended to support teachers in facilitating digital literacy for students with ID and PIMD. The framework focuses on students with moderate, severe and profound levels of learning disabilities who are not literate in the conventional sense (Special Education Support Service, 2014). It delineates a total of six dimensions (access, manage, integrate, collaborate, create and communicate) of digital literacy, which are not hierarchical but rather exist in parallel or are interconnected. It becomes clear that in addition to the "classic" functional skills, a number of other components go hand in hand with digital literacy, so that various starting points for digital education (also) for people with PIMD and CCN can be derived.

5.2. 4As

The 4As scheme, which was developed by by the CESCR (1999) to implement the right to education, is suitable for the design of inclusive education programmes. It provides a framework that identifies four relevant aspects with regard to the design of educational settings and thus ensures the right to, in and through education. As the following figure shows (see Figure 3), these rights are to be achieved by ensuring availability, accessibility, acceptability and adaptability (cf. Tomaševski, 2001):

The concept can also be profitably applied to adult education, which will be explained in the following.

1. Availability:

First of all, it is important to provide educational opportunities and thus ensure the lifelong right to education. In the context of adult education, there is still a need for significant developments as there is currently a lack of both structural and institutionalized measures, as well as conceptual considerations to foster lifelong education.

2. Accessibility:

CESCR (1999) views accessibility primarily from an economic perspective (Tomaševski, 2001). In relation to people with PIMD,

FIGURE 3
4 A Conceptual Framework (Tomaševski, 2001).
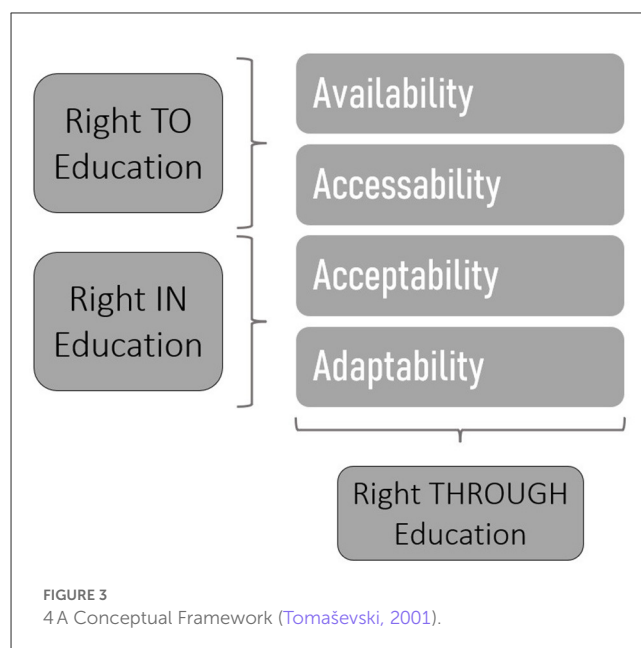
this perspective can be expanded, since in addition to possible financing issues of education services, it is above all questions of mobility and accessibility, reachability and suitable adjustments (e.g., regarding the manner educational content is presented) that can affect this group of people. Accordingly, accessible adult education takes into account different needs and demands, ensures appropriate funding as well as physical reachability and adequate suitable adjustments of the services.

3. Acceptability:

Regarding the acceptability of adult education for people with PIMD, (professional) attitudes and perceptions play a significant role (Copley and Ziviani, 2004; Hoppestad, 2013; Keeley, 2018; Heitplatz et al., 2019). Most providers and services in adult education have limited experience with individuals with disabilities (especially PIMD) and hold reservations toward this target group. The fundamental issue here is the recognition of the right to lifelong education and the claim to a "qualitative" education for people with PIMD.

4. Adaptability:

In order to accommodate the needs and demands of people with PIMD, a person-centered approach must be adopted as the overarching paradigm in adult education. The individual educational needs of the respective person should serve as the starting point for deciding on the content and methodological design of educational services (Dins and Keeley, 2022). At the same time, it is essential to consider relevant topics of adulthood which must inherently guide the identification of educational content. This content must then be prepared in a multimodal and multimethodical manner and take into account the different ways in which people with PIMD acquire knowledge (Nakken and Vlaskamp, 2007; Forster, 2010; Bottcher, 2012; Dins and Keeley, 2022). In this context, digital technologies and multimedia approaches can also assist in effectively meeting the individual communicative and cognitive needs (Grace et al., 2019).

5.3. A conceptual framework for digital education and participation

Basically, there is a lack of (conceptual) approaches to digital adult education for people with PIMD and CCN. The starting points outlined above can be brought together in a conceptional framework (see Figure 4), which encompasses "quality criteria" of digital adult education for people with PIMD (and CCN).

5.3.1. (Digital) availability

Availability refers to the technical infrastructure and structural as well as individual adjustments that address the needs and demands of people with PIMD as well as everybody who uses education services. The potential for empowerment, increased participation and inclusion, which is inherent in digital media, is currently not adequately realized for people with PIMD. These structural barriers in particular prevent participation in and through media and must be considered when designing education services. If we focus on people with PIMD and CCN at this point, a beneficial development can be named: many of these people have an electronic communication aid, which has been increasingly provided in the form of an Ipad for several years (Krstoski, 2016). This means that some of them already have a digital medium and also (basic) digital skills, which can be used as a starting point for extended digital education. However, individual use is still subject to some structural limits (financing, accessibility, etc.) that need to be addressed in the future.

In the context of digital education, it is essential to incorporate specific knowledge about the possibilities, but also the risks and dangers of digital media. Digital education services must customize this knowledge to individual users, considering their unique contexts and circumstances. In addition, at a broader level, it is necessary to incorporate digital perspectives into the mission statements of both service providers and funding agencies, thus ensuring their visibility. Furthermore, adult education programmes and services require fundamental concepts which address not only questions of digital participation but also opportunities to foster digital literacy.

5.3.2. (Digital) accessibility

Accessibility, in this context, primarily refers to the design of education environments, with a particular focus on the individual usability of the utilized media. The potential of the Internet as an audio-visual medium should be emphasized here. At the same time, there is great need for the development of guiding principles with regard to the accessible design of social media. Advancing these conceptual developments and consistently highlighting the existing inadequacies remains an important task. Another framework that can be referenced here is the Universal Design for Learning [Center for Universal Design, 1997; Center
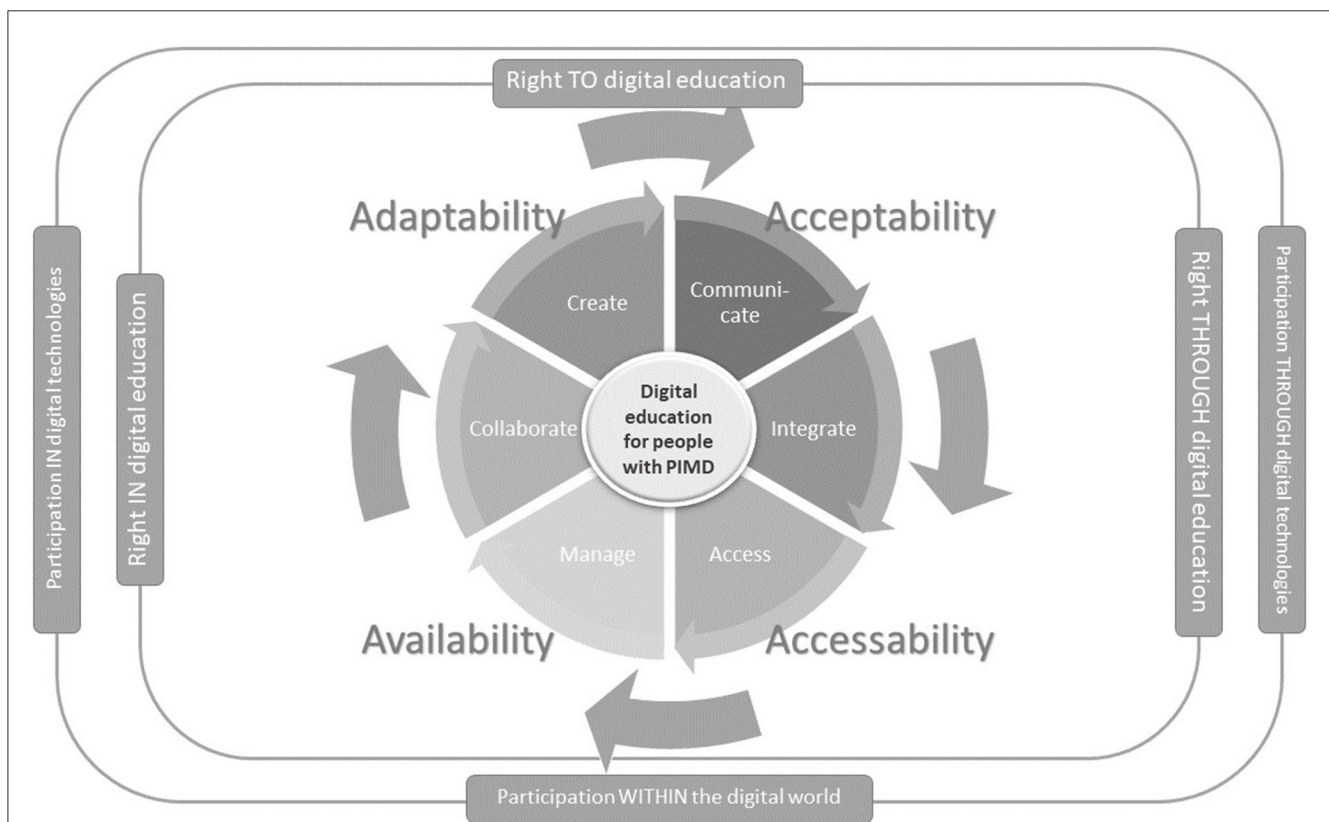

FIGURE 4
Framework of digital education [Own representation with consideration of Tomaševski (2001), Bosse (2014), and Special Education Support Service (2014)].

for Applied Special Technology (CAST), 2018], an initiative which aims at implementing educational environments in a manner that ensures accessibility for a broad range of users. Depending on the cognitive, motor or perceptual functional limitations of the target group, specific adaptations may be necessary, e.g., enhancement of visual contrast, text-to-speech functions, easy language, explanatory videos, etc. Article 2 of the UN-CRPD refers to the concept of 'reasonable accommodation'. Unlike universal design, which is aimed at groups, this concept focuses on the individual case and the specific situation.

According to Bohman and Anderson (2005), possible difficulties that could be encountered with regard to digital accessibility are aspects of "perception and processing" as well as tasks involving "memory, problem-solving, attention." Based on these problems, general recommendations for the design of digital content are that "content should be simple, consistent, clear, multi-modal, error-tolerant, delay-tolerant, attention-focusing" (Bohman and Anderson, 2005). This means that in order to enable digital participation, people's individual needs must be considered, and creative and appropriate solutions must be found. It is also important to explore how multimedia design can support the presentation of content through different sensory ways, so that people with limited and basal capabilities can also benefit from digital education through digital media. Specific guidance for people with ID and PIMD can be found, for example, in the "Top 10 Features" provided by the Institute on Disabilities at Temple University in Philadelphia, which offers suggestions for designing digital content for people with ID (Friedman and Bryen, 2008).

With a focus on expanding digital accessibility in the context of communicative impairments, it is important to use existing access and to legitimize these possibilities for all concerned. This means that the use of digital media as a communication aid should be recognized as a necessary support and therefore financed by the public health care system. In terms of language promotion, the use of these digital tools as digital education could contribute to the expansion of individual possibilities of expression and at the same time represent an expansion of social participation opportunities.

5.3.3. (Digital) adaptability

Adaptability focuses on the possibilities of integrating and using assistive technologies as a prerequisite for participation in social media. This entails, for example, ensuring that social media platforms support screen readers, or that digital services facilitate the integration of AAC devices, or to implement the option to navigate through websites via special keyboards or head mice. Another positive development is named by Kversøy et al. (2020) as follows: "The widespread introduction of touchscreen mainstream devices has changed the accessibility of Internet use for some people with more complex needs." In addition, the development of technology "enables participation in social media, e.g., video telephony via widespread apps or camera recordings of personal experiences as a means of articulation" (Krstoski, 2019; own translation). For AAC and AT users, it is therefore crucial to have digital interfaces for individual communication devices and to

provide enhanced visualization options as well as the possibility to use their own control devices such as a mouth mouse or an external special keyboard.

5.3.4. (Digital) acceptability

Acceptability refers to the form and content of digital education. Content should be transformed and adapted to meet the needs of people with PIMD and CCN. At present, many people with disabilities already use digital media, not only to communicate with others, but also to expand their horizons and explore new opportunities. The described possibilities that arise through the use of AAC media (e.g., recording devices, computers, talkers, tablets) in the context of digital participation can be understood not only as communication support, but also as a basis for educational opportunities (Krstoski, 2019). With the help of these devices, the individual educational opportunities and thus also the existing educational space can be expanded (ibid.).

In addition to one's own participation in the social world, which can be expanded through the use of digital media and functions by people with PIMD and CCN, social media also have an important function for "external representation." Oriented to the postulate of participation IN digital media coined by Bosse (2014), social media platforms offer the potential to make people with PIMD visible as part of society and to enable them new individual possibilities of representation. It is imperative to increase visibility and expand participation formats.

As an aggregation of the presented considerations on the 4 As from a digital education perspective, the following model has emerged, which offers a conceptual framework of digital education.

The framework encompasses the contextual factors to consider when designing digital education services and programmes and relates the considerations of digital literacy to the legal entitlements for (digital) education and participation. The framework can serve as a fundament for the design of services and programmes of digital adult education. In addition to structural requirements, which primarily concern the perspectives of availability and accessibility, the requirement to condense educational content in a way that takes into account both age-appropriateness and subjective relevance poses a significant challenge, as does the methodological processing and design of such content. As described, further challenges arise regarding acceptability when it comes to preparing services in such a way that they meet the needs and requirements of people with PIMD and their ways of acquiring knowledge. In addition to these requirements, it is therefore crucial to ensure that the content of digital education can provide opportunities for experiences and personal growth. Linking individual experiences of engaging with the world through digital media (e.g., the possibility to meet relatives online or to engage in cultural activities), can be just as meaningful and empowering as, for example, experiencing one's own impact through assistive technologies or digital devices that support spoken language. The topic of communication is a section of six different fields of application of digital education but can also be understood as a cross-cutting issue that affects all content-related

aspects as well as the (multi-)methodological approaches and implementation possibilities of digital education. Communication is the basis of human action and accordingly a constituent part of participation. The expansion of digital (communication) possibilities is therefore a central requirement for participation for all.

6. Discussion

In summary, it can be stated that the right to digital education and participation has not been adequately realized for people with PIMD and CCN. The presented framework can serve as a solution to address this issue. By considering the outlined requirements within the framework, appropriately designed educational programs and services can support the development of individual digital competencies. With the expansion of these digital participation possibilities, opportunities for an expansion of communication always arise as well, both in the sense of individual expression (through the use of digital media in the sense of electronic communication aids or through the use of assistive technologies), and in the sense of social communication and interaction, which can be massively expanded through the use of digital technologies (Caton et al., 2022). This can be achieved by providing opportunities to actively engage with digital media, enabling the acquisition and cultivation of knowledge, skills, and reflective abilities.

Overall, digital technologies can be considered 'enabling technologies', offering new opportunities for disadvantaged groups of people. However, there is also an increased risk of social exclusion due to insufficient use of or limited access to digital media. Accordingly, participation in digital media should be supported both through content-related, technical and structural offers and through the promotion of competences in the use of digital media (Luder, 2003).

The support environment plays a central role in the concrete implementation of digital educational programs and services for people with PIMD and CCN. Due to potentially significant impairments, independent use of digital media may not always be possible for this group of people, thus they often require close assistance and guidance. In terms of digital education and participation, supporters play a central role in the sense of a gatekeepers who can either act as barriers or facilitators. It is therefore imperative that supporters have the time and skills to accompany processes in the context of digital literacy. This means that supporters themselves must be competent in dealing with digital media in order to be able to provide guidance and stimulate the development of individual digital literacy skills with empathy and creativity.

The support needs to be provided in a sensitive manner, as people with PIMD and CCN can often only participate in digital education through the personal support in the sense of a person who selects, produces or activates content on behalf of the person with PIMD. In the context of participation in digital media, this can mean, for example, that content is selected or deliberately withheld for people with PIMD and CCN. It may also involve actively producing and publishing content with their involvement, e.g., through a blog or a WhatsApp group. This can be encouraged through guided and conjoint exploration or support for active participation. However, the aspect of acting on behalf of others remains a highly sensitive process that requires constant reflection on the part of the supporters. This does not only involve technical skills in handling devices and software, but also employing information and communication technologies that aim at shaping social practice (Wagner and Peschke, 2006).

Ultimately, participation in digital education is a basic right for people with PIMD and CCN, which has only been partially realized so far. Accordingly, it is necessary to further develop concepts and services on all levels mentioned—in terms of content, technology and infrastructure—while also critically reflecting on the adequate support and assistance. By facilitating experiences, the support environments of people with PIMD can facilitate long-term individual digital participation and thus contribute to fulfilling this right. The mere use of digital technology is therefore by no means sufficient to enable participation. Professional and informal assistance, human interaction and social support are required.

This requires further research with regard to actual avenues and possibilities for access, as well as identifying the barriers and challenges. Beyond that concrete concepts are needed that enable joint exploration of the digital space for both people with PIMD and CCN and their supporters. This can lead to a mutual increase in competence. The developed framework can provide a foundation for such endeavors.

Author contributions

CK and TB contributed the conception, design of the analysis, and wrote the manuscript. All authors contributed to manuscript revision, read, and approved the submitted version.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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