



Social Inclusion for People with Intellectual Disability and on the Autism Spectrum through Assistive Technologies: Current Needs and Future Priorities

Carla Sousa, Paulina Tsvetkova, Patricia Pérez-Fuster, May Agius, Snezhana Kostova, Karolina Bolesta, Flávia Megda Garcia, Benjamin Nanchen & Alan H. Tkaczyk

To cite this article: Carla Sousa, Paulina Tsvetkova, Patricia Pérez-Fuster, May Agius, Snezhana Kostova, Karolina Bolesta, Flávia Megda Garcia, Benjamin Nanchen & Alan H. Tkaczyk (24 Oct 2024): Social Inclusion for People with Intellectual Disability and on the Autism Spectrum through Assistive Technologies: Current Needs and Future Priorities, *Disability and Rehabilitation: Assistive Technology*, DOI: [10.1080/17483107.2024.2414414](https://doi.org/10.1080/17483107.2024.2414414)

To link to this article: <https://doi.org/10.1080/17483107.2024.2414414>



© 2024 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group.



Published online: 24 Oct 2024.



[Submit your article to this journal](#)



Article views: 948



[View related articles](#)

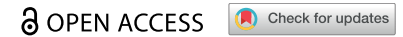


[View Crossmark data](#)












Citing articles: 1 [View citing articles](#)

RESEARCH ARTICLE



Social Inclusion for People with Intellectual Disability and on the Autism Spectrum through Assistive Technologies: Current Needs and Future Priorities

Carla Sousa^a , Paulina Tsvetkova^b , Patricia Pérez-Fuster^c , May Agius^d , Snezhana Kostova^b , Karolina Bolesta^e , Flávia Megda Garcia^f , Benjamin Nanchen^g  and Alan H. Tkaczyk^h 

^aLusófona University, CICANT, Lisbon, Portugal; ^bInstitute of Robotics, Bulgarian Academy of Sciences, Sofia, Bulgaria; ^cDepartment of Developmental and Educational Psychology, Faculty of Psychology and Speech Therapy, Universitat de València, Spain; ^dDepartment of Communication Therapy, Faculty of Health Sciences, University of Malta, Msida, Malta; ^eDepartment of Economics I, Warsaw School of Economics, Warsaw, Poland; ^fResearch Group on Vulnerability and Health - NAVES, Federal University of Minas Gerais, Minas Gerais, Brazil; ^gHES-SO Valais-Wallis, Living Lab for Special Needs, Sierre, Switzerland; ^hInstitute of Technology, University of Tartu, Tartu, Estonia

ABSTRACT

Context: Contemporary technologies, such as mainstream and specialised Assistive Technologies (ATs), are seen as effective. However, there is a noticeable gap between technological progress and the ability to customise these technologies to meet the unique needs and characteristics of neurodivergent individuals, particularly those on the Autism Spectrum and people with Intellectual Disability (pwID).

Purpose: The goal of this study is to investigate the present requirements and future priorities acknowledged by specialists in the field regarding the progress of social inclusion for this population, making use of ATs.

Methods and results: A qualitative survey involving 24 international experts, and its respective thematic analysis reveals challenges in social inclusion, emphasizing communication and physical accessibility, awareness gaps, and stigma. Concurrently, issues surrounding ATs include limited access, insufficient training, and a lack of awareness and skills, with individuals, and families being inadequately involved.

Conclusion and implications: The study proposes strategies for overcoming these challenges, with a focus on accessibility, awareness, skills, family involvement, and customization. Identified research needs encompass scientific development, inclusive approaches, and changes in technological development paradigms.

ARTICLE HISTORY

Received 9 April 2024
Revised 17 August 2024
Accepted 4 October 2024

KEYWORDS

Assistive technologies; social inclusion; intellectual disability; autism; support needs

> IMPLICATIONS FOR REHABILITATION

1. *Customization and Accessibility of Assistive Technologies (ATs):* The research emphasizes the critical gap between existing ATs and their alignment with the needs of people with Intellectual Disability (pwID) and those on the autism spectrum. This is crucial for rehabilitation since its effectiveness is based on the consideration of individual requirements. In this sense, the present study involves enhancing the adaptability of technologies to support varied communication styles and learning abilities, thereby promoting greater independence and participation in daily activities, also through rehabilitation.
2. *Policy and Infrastructure Development:* In an innovative manner, the study points out the systemic challenges, including inadequate policies and lack of support infrastructure, that hinder the effective use of ATs. For rehabilitation practices to be impactful, there is a need for policy reform and infrastructure development that prioritizes the provision and integration of ATs into education, employment, and community living. This includes ensuring funding for AT acquisition, creating inclusive educational and work environments, and improving public spaces to accommodate the needs of pwID and on the autism spectrum.
3. *Involvement of Individuals and Families in the AT Development Process:* The paper highlights the limited involvement of individuals with ID and on the autism spectrum, and their families, in the process of developing and selecting ATs. Therefore, an important implication for rehabilitation is the need to adopt a person-centred approach that actively involves these individuals and their families in decision-making processes and, whenever possible, in co-creation processes. This approach ensures that AT solutions are better suited to the users' preferences, challenges, and daily life contexts, thereby enhancing the effectiveness of technological aids in supporting social inclusion and autonomy.
4. *Adoption of Qualitative, In-Depth Methods in AT Research:* The adoption of qualitative research methods in disability and health research significantly contributes to the development of human-centred, context-driven, and personalized technologies and rehabilitation strategies.

CONTACT Carla Sousa  carla.patricia.sousa@ulusofona.pt  Lusófona University, CICANT, Portugal.

© 2024 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group.

This is an Open Access article distributed under the terms of the Creative Commons Attribution-NonCommercial-NoDerivatives License (<http://creativecommons.org/licenses/by-nc-nd/4.0/>), which permits non-commercial re-use, distribution, and reproduction in any medium, provided the original work is properly cited, and is not altered, transformed, or built upon in any way. The terms on which this article has been published allow the posting of the Accepted Manuscript in a repository by the author(s) or with their consent.

Introduction

The support needs of neurodivergent people, particularly those with Intellectual Disability (ID) and those on the Autism Spectrum, are mainly related to cognitive and communication aspects of life (1,2). With the rise of contemporary technology, in terms of so-called mainstream technologies and Assistive Technology (AT) products, it seems to be becoming increasingly feasible to provide support for these needs in a relatively easy way.

Nevertheless, there appears to be a disparity between the rate of technological advancement and the ability to tailor each product to the unique requirements and attributes of individuals (3). Likewise there is a lack of comprehensive research on this relationship, which hinders the ability of Assistive Technologies (ATs) to effectively foster social inclusion.

Considering this context, and adopting a qualitative research approach, this study aims to explore the current needs and future priorities recognized by experts in the field of social inclusion for people with Intellectual Disability (pwID) and those on the Autism Spectrum through the utilisation of ATs. By exploring the existing literature and employing a qualitative methodology, the research endeavours to offer in-depth insights, and facilitating a nuanced understanding that can inform the development and implementation of effective strategies to enhance social inclusion for these specific populations.

Intellectual Disability (ID) and Autism

Neurodiversity is a term coined to bring individuals historically diagnosed with conditions considered "disorder underpinned by dysfunction", to a concept closer to the field of civil rights (4, p.559). In this way, a neurodivergent person can exhibit brain structure and functioning that are different from those of the majority of the population without the concept of neurodiversity being solely based on the losses these differences cause. Thus, neurodiversity also acknowledges the benefits and particularities – both social and personal – that such conditions can bring. Within this context, the notion that neurodiversity inherently causes harm is dismissed, and the individual's subjective experience is considered just as, if not more, important than the principles previously defined by the fields of medicine and science. Furthermore, recognising the notion of neurodiversity rather than focusing on disorders requires understanding the individual's surroundings and devising suitable adaptations to enable them to fully realise their potential within that context. This is all part of a multidisciplinary effort to fight stigma and promote the social inclusion of such individuals (4). The scope of neurodiversity encompasses the diagnosis of Dyspraxia, Autism Spectrum Disorder (ASD), Attention Deficit Hyperactivity Disorder (ADHD), Dyslexia, Dyscalculia or Synaesthesia and other neurodevelopmental conditions (5,6).

Considering a medical denomination, according to the Diagnostic and Statistical Manual of Mental Disorders-5 (DSM-5), ASD consists of a neurodevelopmental disorder in which the child necessarily presents deficits in social-emotional reciprocity, non-verbal communication used for social interaction, and in the creation, understanding, and maintenance of human relationships. In addition, the child must exhibit two of the following four characteristics: (1) stereotypies or repetitions of movements/speech; (2) inflexibility to change; adherence to ritualized patterns of behaviour and routine rigidity; (3) interests restricted with unusual intensity; and (4) altered reactivity (hyper or hypo) to environmental sensory stimuli, such as light, sound, tactile, olfactory, and

gustatory experiences (7). Such characteristics must be present early in childhood.

Regarding ID, the same manual establishes that deficits in intellectual functioning and adaptive functioning – such as deficits in the areas of language, social skills, functioning at work, and studies – are expected (7). Some diagnoses are listed as etiological roots of ID such as Fragile X Syndrome, Down Syndrome, and Prader-Willi Syndrome, among others.

In this article, we will focus on ID and Autism with an ideological view on neurodiversity. It is also important to point out that the notion of neurodiversity, as a conceptual and unifying whole, is not yet commonly accepted among experts and, for this reason, the specific terms of ID and Autism were adopted in the data collection strategies implemented. Thus, using the paradigm of neurodiversity as a theoretical unit – even though disability is often mentioned during the study – allows us to emphasise how barriers to participation are caused by a mismatch between the needs of individuals and the context (8), which can be mitigated by ATs. In this context, we chose to always refer to people with ID using the term "people" first to avoid reducing them to this condition and, thus, disregarding their human capabilities and particularities. Likewise, we chose not to use the term "disorder" to refer to people on the Autism Spectrum. This position is expected to align the present study with a depathologising view that enhances its cultural competence (9). We believe that neurodiversity is a concept that helps us fight against stigmatisation and promote social inclusion, which are key points of our current work regarding ATs.

These two specific variations – ID and Autism – within what can be considered neurodivergences, were chosen as the focus of this study because the support needs that emerge from them are, in both cases, mainly at the communicational and/or cognitive domain (10, 11). In addition, their comorbidity is very high (12), presenting complex and multidimensional daily challenges (13).

Assistive technologies (ATs) and social inclusion

The World Health Organisation (14) has stated that AT products refer to "products that maintain or improve an individual's functioning and independence, thereby promoting their well-being". The International Standards Organization (ISO) defined ATs as "any product (including devices, equipment, instruments, and software), specially produced or generally available, used by or for persons with disabilities, available, used by or for persons with disability for participation to protect, support, train, measure or substitute for body functions structures and activities, or to prevent impairments, activity limitations, or participation restrictions". AT that adequately meets an individual's needs should, however, be viewed within an ecosystem that encompasses more than the products themselves. WHO (14), in fact, also states that AT refers to the skills and knowledge associated with the systems and services required to provide AT to individuals. This ecosystem is clearly described in WHO's 5P model, which places the person who requires AT at the centre of the model surrounded by policy, products, provision, and personnel.

These elements of an AT system are set within the context of the Convention on the Rights for Persons with Disabilities (CRPD) which lays down a foundation for equal rights for persons with disabilities. Article 19, for example, refers to the right to community living, thus promoting social inclusion. Other articles of this convention refer to employment and education, which also promote social inclusion. In this context, AT can be used to increase

effective social participation instead of only supporting community care, historically intended for people with disabilities (15). This possibility is crucial as these topics become significantly important in society.

AT can be viewed as an important means to achieving the rights that are laid down in this convention. Furthermore, in a review performed by Torrado et al. (16), it is noted that personal autonomy, one of the catalysts of social inclusion, is the main goal of using AT, followed by assistance and monitoring of the user and increased possibilities of interaction. The WHO (14) note that ATs can support people with disabilities to achieve social inclusion and reduce the impact of disability on community participation. Specifically, MacLachlan et al. (17) describe how AT can play an important role in supporting access to education and employment, thus promoting social inclusion and an increased sense of well-being while combating social exclusion. This is significant because the use of ATs must be viewed within the context of community participation and the interpersonal relationships that take place in these situations to consider the achievement of social inclusion (18). Moreover, ATs can also be significant for several typologies of users (19), being able to enhance their communication, and effective social participation (20).

AT products refer to a wide range of products that may be low- or high-tech. The vastness of products that are available on the market is apparent when inventories such as those provided by the European Assistive Technology Information Network (EASTIN) are viewed. Furthermore, increasingly, mainstream technology, which has been designed to meet the needs of the majority of the population, is also serving the needs of those with disabilities and can therefore be considered on the continuum of AT products. New mainstream technologies are continually being developed – such as smartphones, smartwatches, and respective apps – which may also be utilised by persons with disabilities to support their social inclusion. In this way, the use of technologies presents benefits, as they can be adapted to the level of understanding of the user (21). It is important to note that these products remain just technological devices if they are not utilised to support active participation in society, and therefore the context in which they will be used should also be considered. Nierling and Maia (22) suggest what they refer to as a socio-technological approach to describe both the AT product and the setting in which it will be used to promote social inclusion. This must, however, also refer to the individual who may benefit from the AT in a person-centred approach. This is necessary when it is considered that the impact of a disability varies from individual to individual and this impacts the choice of AT in promoting social inclusion.

For autistic individuals and/or those with ID, many positive advancements have been made in the area of AT (22). These include communication aids, which may be used for face-to-face communication, as well as for remote communication, which can be synchronous, e.g., using Messenger in real-time, or asynchronous, e.g., using emails. These are essential when it is considered that difficulties in communication and participation in social interactions are a fundamental part of the Autism diagnosis and also evident for individuals with ID. It is important to highlight the increased use of educational applications on smartphones and tablets in this context. These devices are extensively used by people without disabilities, which can help to tackle the stigmatization concerning the use of ATs (23). Such AT may be used in different settings, including the school, the workplace, and other community settings. Evident challenges include the lack of language availability for all European idioms as well as the need for further research on how to provide intervention to support autistic

individuals and/or those with ID to learn to use these communication aids.

The use of AT to support children in school settings has a long history. This is of particular importance when it is considered that the learning that takes place in a school setting is a stepping stone to the independence that comes during adulthood. AT products used in this setting include software designed to support learning. Some children may require products that support their access to computers. Increasingly, children have greater access to computers and tablets, but issues of professional training to support their use and concerns about online safety and privacy have emerged (22).

When considering employment, the use of AT can make the labour market easier to access. ATs can support autistic individuals and/or those with ID in many ways, for example, artificial intelligence can be applied in video games to simulate social situations and work tasks. Socially Assistive Robotics (SARs) are technologies currently used to improve social skills, emotional modulation, and facial expression recognition. They are related to substantial improvements in autistic children's social performance, such as an increase in eye contact (24). In addition, SARs have demonstrated their efficacy as valuable instruments in speech and language therapy, fostering communication skills in both children and adolescents (25). Applications that target video modelling and scheduling can support individuals with disabilities to complete tasks and work more independently. Previous research has raised concerns about the matching of AT to personal processes as often the professionals lack experience in how to assess and the lack of policies at national levels to support the implementation of AT at the local level (17).

Expert interviews have been conducted to determine future directions for research in the field of AT, such as the ones from Nierling and Maia (2020). This study refers to data from 14 expert interviews carried out in 2016. This paper concluded that further information on the use of AT in different societal contexts is warranted as well as further development of technologies for individuals with ID.

The development of ATs to be used for the benefit of autistic people and/or those with ID is multidisciplinary and requires collaboration and engagement from individuals in the fields of health care, information technology, and engineering, among others. Furthermore, research in the area is still scarce, as barriers such as data analysis difficulties, insufficient samples and technological malfunctions are common. Therefore, the scientific literature still presents a gap in evidence regarding the benefits found through the use of ATs and the cost-benefits. Therefore, new research methods are necessary to delve deeper into the area (16). Finally, the importance of developing research in the area covers the still small percentage of individuals with disabilities covered by these technologies. Social inclusion must be assessed in multiple facets, regarding socioeconomic and cultural particularities (15). New scientific efforts are needed to better understand the multifactorial particularities of the relationship between the use of ATs and effective social inclusion of people with ID and those on the Autism Spectrum, namely exploring the paths to foster their role in the development process (26).

Methodological approach

Expert consultation in qualitative research is highly relevant due to several key advantages. Experts contribute specialised knowledge and experience, enriching the research with nuanced

perspectives while being able to identify relevant variables, guide methodological choices, and validate findings (27). Their involvement in knowledge production ensures the depth, validity, and practical relevance of qualitative research, making it a valuable and comprehensive method for gaining insights in various fields (28).

At a socio-historical level, the inclusion of the perspectives of these experts – who aim to understand the current landscape to make it more equal – can be situated in the vision of action research developed by Kurt Lewin (29). In other words, in addition to understanding the phenomena, the aim is to build an agenda for action through the research itself (30). Therefore, this study adopts a critical epistemological perspective, which aims to “critique and challenge, to transform and empower” (28, p. 10). Particularly, this comprehensive survey of future research priorities aims, in addition to listing them, to explore strategies for change in which ATs can contribute to a fairer and more equal society.

For the operationalization of qualitative data analysis, thematic analysis was adopted – as defined by (31,32). This method involves systematically identifying, analysing, and reporting patterns or themes within a dataset, with a vision of continuous reflexivity and refinement. Its ultimate goal is to organize and make sense of qualitative data in a way that captures the underlying patterns and meanings.

In ensuring the rigour and validity of our qualitative research, we employed the Journal Article Reporting Standards for Qualitative Research (JARS Qual; 33) as a guiding framework. It provides a systematic and transparent approach to reporting qualitative research, emphasizing key aspects such as reflexivity, transparency, and rigour. By adhering to these guidelines, we aimed to enhance the credibility of our methodological choices, participant selection, data collection procedures, and analysis methods. Additionally, it facilitated the transparent reporting of the findings,

allowing readers to assess the potential transferability and dependability of our research.

Considering the presented state-of-the-art and methodological approach, the present study aims to answer the research question: What are the current needs and the future priorities identified by experts in the field to enhance the social inclusion of pwID and people on the Autism Spectrum through the implementation of ATs?

Materials and methods

Participants

The sample of this research consisted of 24 experts in the field of inclusion and empowerment through ATs, from 20 countries, 18 of them in Europe, one partly in Europe and Asia (Türkiye) and one in Latin America (Brazil). Except for the last country, the geographical distribution of the sample is shown in Figure 1. To ensure the quality and uniformity of the data collected, the experts' experience with both ATs and the two populations under study – pwID and people on the Autism Spectrum – was taken into account when selecting this sample.

Non-probabilistic sampling was implied, with the recruitment taking place by convenience, through a collaborative network of researchers studying the empowerment and social inclusion of people with ID and Autism. The purposive sample was, for this qualitative study, a fundamental resource given the need explored above to guarantee a match between the participants' expertise on social inclusion of this population and their recruitment to the study (34).

The survey was sent to a total of 27 people, with a response rate of 88.89%. Regarding the areas of expertise, and considering each individual's highest finalized degree, the majority of the experts were from the field of Computing ($n=7$; 29.17%), followed by those with specific degrees in Inclusive Technologies ($n=4$;

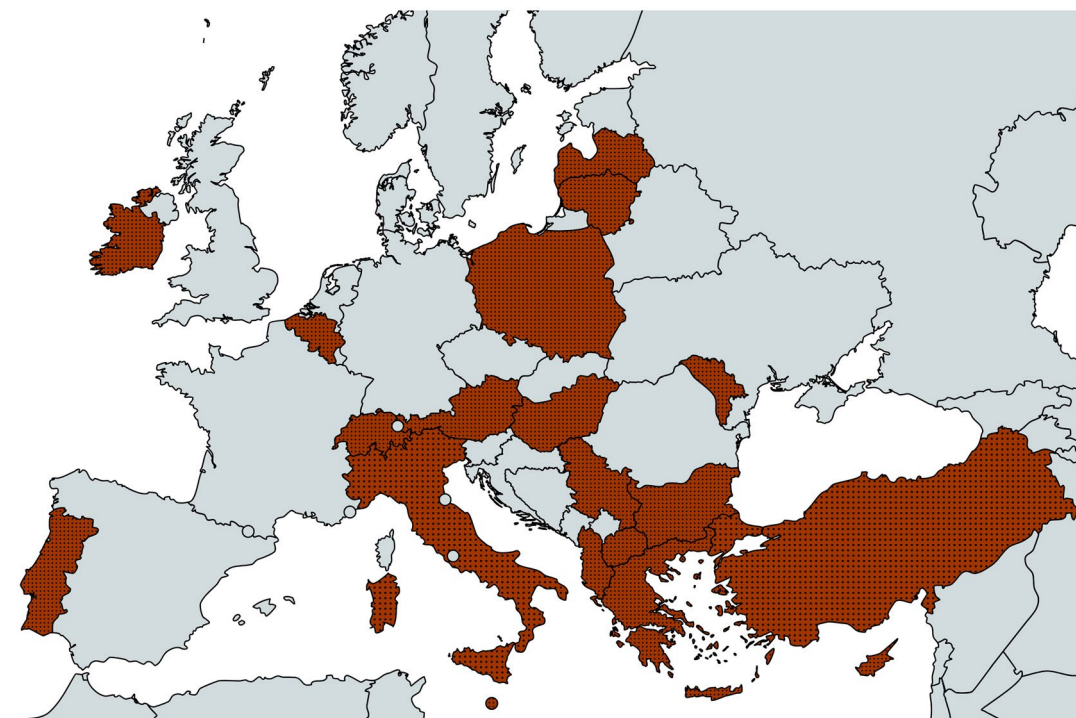


Figure 1. Coverage of the sample of experts, considering the European map. Note: there is a participant from Brazil, that is not considered in the map. Source: Authors' elaboration.

Table 1. Sample distribution, according to countries and areas of expertise (N=24).

Country (n of participants; % in sample)	Main area(s) of expertise
Albania (n = 1; 4.17%)	Education
Austria (n = 1; 4.17%)	Linguistics
Belgium (n = 2; 8.33%)	Education and Linguistics
Bulgaria (n = 3; 12.50%)	Computing, Mathematics, and Psychology
Brazil (n = 1; 4.17%)	Medicine
Cyprus (n = 1; 4.17%)	Inclusive Technology
Greece (n = 1; 4.17%)	Computing
Hungary (n = 1; 4.17%)	Computing
Ireland (n = 1; 4.17%)	Psychology
Italy (n = 1; 4.17%)	Inclusive Technology
Latvia (n = 1; 4.17%)	Sports
Lithuania (n = 1; 4.17%)	Education
Malta (n = 1; 4.17%)	Inclusive Technology
Moldova (n = 1; 4.17%)	Economics
North Macedonia (n = 1; 4.17%)	Computing
Poland (n = 2; 8.33%)	Computing and Inclusive Technology
Portugal (n = 1; 4.17%)	Communication
Serbia (n = 1; 4.17%)	Public Health
Switzerland (n = 1; 4.17%)	Computing
Türkiye (n = 1; 4.17%)	Computing

16.67), the field of Education (n=3; 12.50%), Linguistics (n=2; 8.33%), and Psychology (n=2; 8.33%). The remaining areas had only one specialist each, as shown in Table 1.

Instrument

This research capitalised on the relevance of open-ended questions as a data collection technique, namely because of their potential to capture beliefs and meanings, regardless of the primary beliefs of the research team, as explored by Singer & Couper (35, p.127):

Instead of simply forcing respondents to agree (or otherwise) with the statements we proffer, or pick one of the responses we provide, we can allow them to tell us what's on their mind concerning the topic under discussion.

Therefore, data collection was based on a survey with five key questions, which required each of the experts to provide open-ended answers on topics related to the research objective:

1. What are the current challenges relating to social inclusion for individuals on the Autism Spectrum and/or with ID?
2. What are the current challenges relating to the use of AT for individuals on the Autism Spectrum and/or with ID?
3. What research is needed to address the challenges outlined in (1) and (2)?
4. What other actions are needed to address these challenges?
5. Please describe three potential future scenarios relating to social inclusion and/or the use of ATs for individuals on the Autism Spectrum and/or with ID that would have a significant impact.

Basic demographic data was also included, which would better enable each person and their beliefs to be framed within the socio-cultural context in which they live.

Procedure

The survey was sent by e-mail to the members of a working group on the evaluation of ATs as part of an international research

network. The responses were collected and then analysed. As above mentioned, the data analysis was conducted according to the premises of thematic analysis developed by (31,32). The process of constructing thematic maps was divided into two stages. Firstly, it analysed the themes of the survey questions. Secondly, it established a new conceptual structure that encompassed recurring themes across various questions. This second step was also guided by the principle of prioritization, defined by Saldaña (36) as a moment of reduction of the corpus of analysis and meanings inherent to the essence of the research objective.

In this process of simplifying and collecting emerging themes, it is important to note two conditions: (a) to draw up the first thematic maps, the emerging themes indicated by six or more experts (25.00%) were considered; and (b) the themes of any of the thematic maps are not necessarily mutually exclusive, but may have common meanings within the social and cultural context of people with ID and on the Autism Spectrum.

Results

The results of the thematic analysis are presented here, as explained above, in a progressive manner. Sections "Current challenges for the social inclusion of people with ID and on the Autism Spectrum, Current challenges related to the use of ATs by people with ID and on the Autism Spectrum, Research needs, and Other needs" present the initial thematic maps, analyzed from the answers to the survey questions. In section "Future scenarios", a structure is proposed which prioritizes the most relevant emerging themes, in a complex conceptual structure which is adjusted to the proposed research objective.

Current challenges for the social inclusion of people with ID and on the Autism Spectrum

In the analysis, lack of accessibility emerged as the main theme mentioned under the current challenges for the social inclusion of pwID and people on the Autism Spectrum (n=12). In this thematic area, communicational accessibility or, in this case, the lack of it, was mentioned by 10 of the participants, focusing on aspects such as the scarcity of materials in easy-to-read formats, symbolization and guidelines to support the development of such materials. The lack of physical accessibility of public spaces was also mentioned (n=3), given that most of them are not considered to promote the autonomy of people with these characteristics. Another aspect mentioned concerning accessibility was how full citizenship in contemporary society requires individuals to have levels of digital literacy that not all autistic people and/or those with ID have (n=2), as mentioned by one participant:

you need smartphones everywhere - for example QR code for the menu in the restaurant, to buy a ticket on the bus, to check the public transport timetable, etc... Not all people with Autism or ID can handle smartphones and other digital devices.

Stigma was then considered the most prevalent barrier to social inclusion for these people (n=10). Stigma can have several facets and be analysed through different lenses. In the case of the sample surveyed, it was mentioned how segregation is still an approach to the place of people on the Autism Spectrum or with ID in society (n=6). Here, how spaces such as "special education" schools or other non-inclusive models are still given preference was emphasized, and the role of these "rehabilitative" models in limiting social and emotional expression and, consequently, inclusion was mentioned. Aspects related to stigma are

also seen as a significant barrier to seeking adequate support, particularly on the part of families ($n=4$), as mentioned: "the stigma prevents many parents from accepting that their children might need to be checked by specialists to identify their abilities or different abilities". Also in this context, overprotection and infantilization appear as aspects of stigmatization ($n=1$).

Another theme that emerged from the information gathered from the participants is the lack of awareness of the specific needs of this population ($n=9$). In this regard, all the participants pointed out that this lack is reflected in the general public or society as a whole. In addition, one participant highlighted this shortcoming in public services, while another spoke of the lack of awareness in family contexts.

Also highly emphasized was the lack of relevant training, namely that which corresponds to the specific needs and characteristics of autistic people and/or those with ID ($n=10$). Here, the importance of training for teachers, educators and other actors in educational contexts was highlighted ($n=9$), as well as a need to focus on practical rather than theoretical training ($n=2$).

Participants also highlighted barriers to independent living as relevant to consider in this analysis ($n=7$), including lack of support services ($n=5$), lack of infrastructure ($n=3$) and lack of policies ($n=1$).

As opposed to a view more focused on the inability of the context to absorb the needs of autistic people and/or those with ID, some participants mentioned that the characteristics of these neurodiverse people hinder their inclusion ($n=5$). In this context, they mentioned their difficulty in establishing cohesive interpersonal relationships ($n=5$), the sensory overload they often experience ($n=2$), and their difficulties in terms of adaptive behaviour ($n=1$).

At a more systemic level, the lack of investment or support from states ($n=4$) and the lack of correspondence between legal frameworks and the impact of inclusion measures on the daily lives of these people ($n=1$) were mentioned. In addition, a dimension related to how disability is combined with other conditions of discrimination was also addressed ($n=3$), including aspects such as unemployment ($n=2$) or poverty ($n=1$). One participant even mentioned that she considered the social exclusion of these people to be "multidimensional".

In the thematic map of the challenges to the inclusion of people with ID and on the Autism Spectrum (Figure 2), in addition to systematizing the results explored above, we explored the potential conceptual relationships that exist. For example, how a lack of accessibility conditions their independent living, or a role for a lack of awareness and appropriate training in stigma.

Current challenges related to the use of ATs by people with ID and on the Autism Spectrum

Concerning the challenges that emerge from the use of ATs by people with ID or on the Autism Spectrum, two themes emerge with similar frequency. Limited access to ATs ($n=10$), with some participants particularly focusing on the fact that they are not affordable ($n=5$) in their countries and specific contexts. Similarly, the lack of awareness about ATs and the lack of skills to support their use are considered crucial barriers for this population ($n=10$), either on the part of educators or other actors in the educational process ($n=7$), or on the part of support staff ($n=5$), or even health professionals ($n=3$). In addition, participants emphasized their lack of awareness of the complexity of the process of monitoring and adhering to ATs ($n=4$).

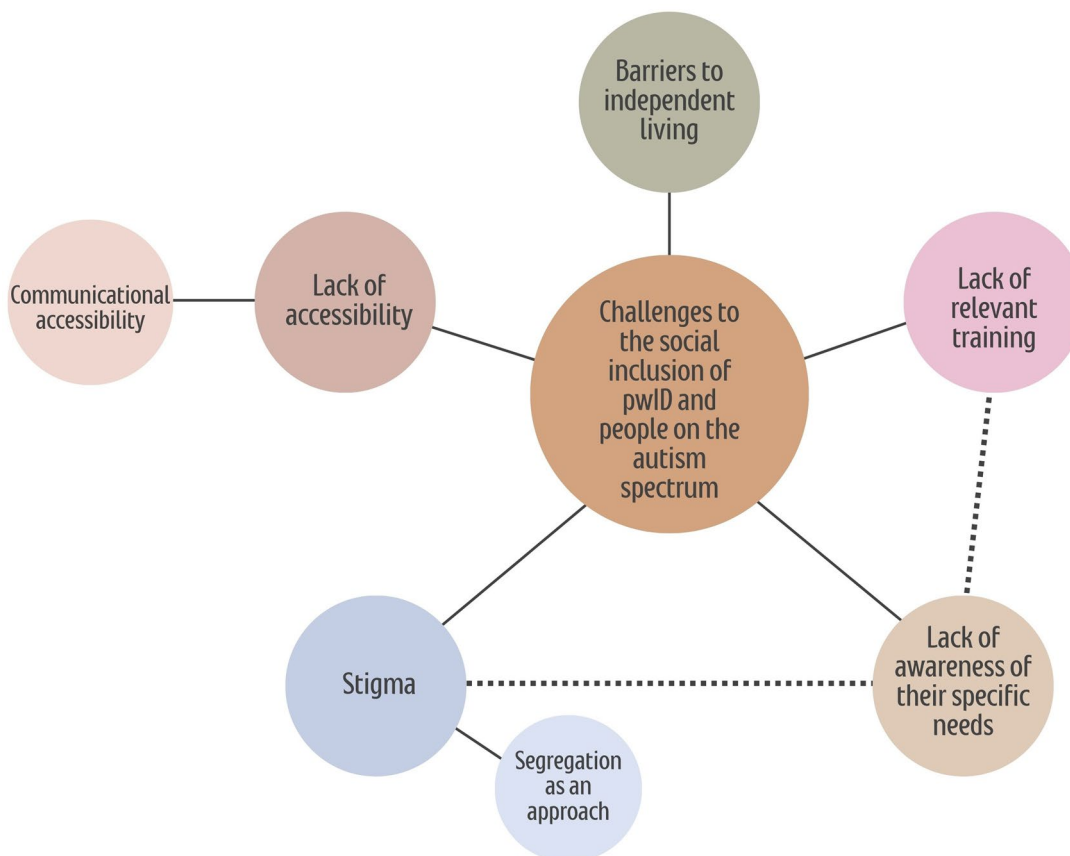


Figure 2. Thematic map of the challenges to the inclusion of people with ID and on the Autism Spectrum. Source: Authors' elaboration.

Next, the lack of accessibility of ATs was mentioned ($n=9$), characterized by one participant as a "poor match between the needs of the person and the technology". In this context, the lack of cultural validation and/or language adaptation of various technologies ($n=4$) was highlighted, particularly for languages with fewer speakers. One participant critically characterizes this translation and adaptation as "not interesting from an economic point of view". The lack of options or processes for customizing technologies ($n=3$) and problems with user interfaces ($n=1$) are also highlighted here.

Equally important is limited access to training in the use of ATs for autistic people and/or those with ID ($n=6$) and the lack of follow-up mechanisms after assessment and service provision ($n=6$). This conjunction can be associated with the "high abandonment rates" mentioned by one participant. Six participants also discussed in their answers the existence of limited support guidelines, which are specific to the assessment of the technology needed ($n=3$), whether aimed at practitioners ($n=2$) or policymakers ($n=1$).

The limited involvement of families in the whole process is also seen as a barrier ($n=5$), bringing up a problem that has also been discussed: the lack of transferability of the gains in ATs inclusion outside the therapeutic and rehabilitation settings ($n=4$). This notion is better shown by a participant's quote, saying "AT devices, when available, are given without a customization and often only for rehabilitation activities more than for real inclusion in life areas: school, home and social life".

In this area too, intersectionality was an emerging theme. In other words, how other problems of discrimination or lack of privilege are associated with barriers to the use of ATs was mentioned ($n=2$), with aspects such as "low income" or "single-parent families" being indicated.

Finally, the following were also mentioned: the limited evidence on the effectiveness of some specific technologies ($n=1$); and the existence of misconceptions about ATs, such as the need for them to be high-tech ($n=1$).

In the thematic map of the challenges to the use of ATs by people with ID and on the Autism Spectrum, shown in Figure 3, the main emerging themes are presented. It also explores a potential triad between the lack of skills to support the use of ATs, the lack of accessibility of these technologies – which necessarily makes them more complex – and limited access to training in this area.

Research needs

Regarding the needs in the field of scientific research that could potentially meet some of the needs identified, the need to develop some specific fields or themes was highlighted above by the participants ($n=19$). In this context, they highlighted the need for a broader understanding of social inclusion as an outcome of the use of ATs in this population ($n=8$), as well as the study of their use and impact in educational contexts ($n=6$). In addition,

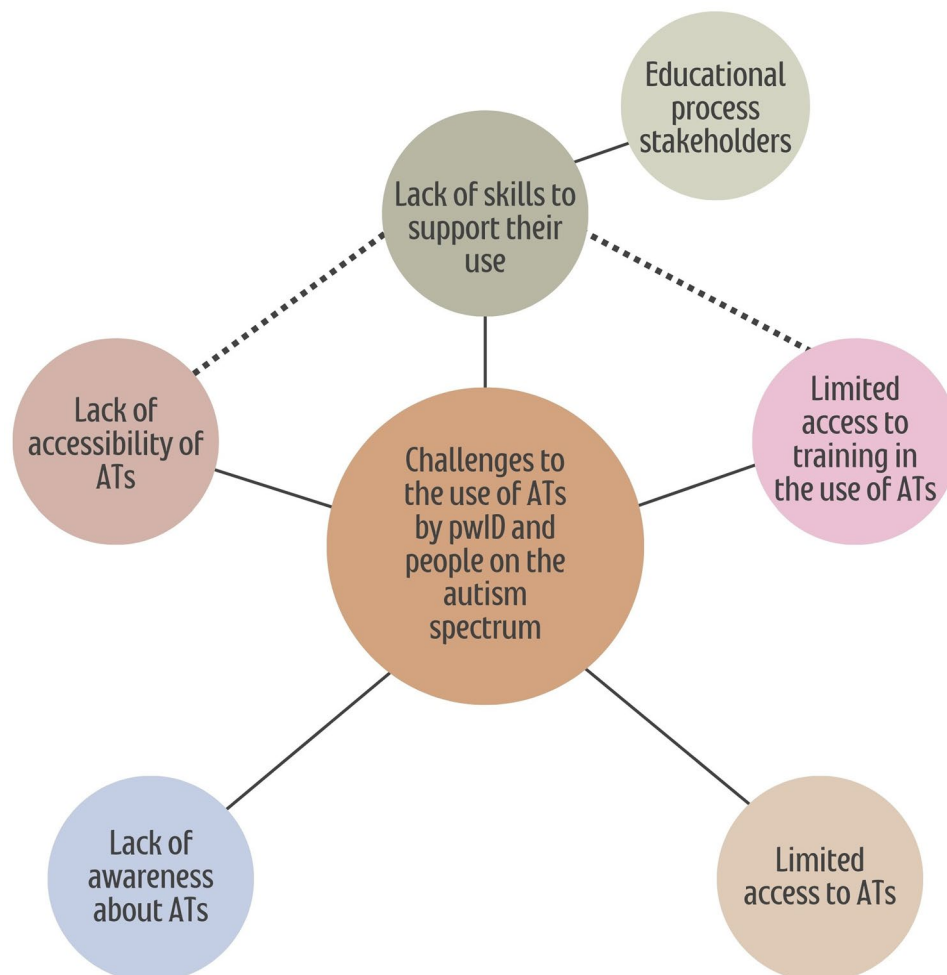


Figure 3. Thematic map of the challenges to the use of ATs by people with ID and on the Autism Spectrum. Source: Authors' elaboration.

the need to explore existing provision services was highlighted ($n=8$), particularly concerning their capacity for "effective person-technology matching", as mentioned by

The study of their accessibility ($n=5$) was also mentioned, including their cultural adaptation and approaches to the study of more affordable evaluation processes, as well as the reduction of ATs costs ($n=4$), expressed in detail by one participant: "Make AT based on cheap and accessible (open) hardware such as smartphones, tablets, but also embedded platforms, like Arduino boards, Raspberry Pi-s etc. Also, make the software free and open source so everybody can use it".

Still, in terms of areas to be developed, the participants mentioned the need to study in greater depth the life contexts of people with ID and/or on the Autism Spectrum ($n=4$), namely by reinforcing the intersectional view raised in the previous results, on issues of poverty or how exclusion subsequently impacts them at work level. In addition, they discussed the need to explore customization options and the user experience (UX) of ATs ($n=4$), implementation processes ($n=2$), inherent ethical issues ($n=1$), work contexts ($n=1$), use in health services ($n=1$), and increased focus on adult populations ($n=1$). Some participants mentioned the need for further research into specific technologies such as robotics ($n=3$); Augmentative and Alternative Communication (AAC; $n=2$); Artificial Intelligence (AI; $n=2$); digital games ($n=1$); Virtual Reality (VR; $n=1$); or eye-tracking ($n=1$).

Under a more methodological lens, the need to develop more inclusive and participatory research ($n=11$) was highlighted, especially through the involvement of end users ($n=8$), but also other stakeholders ($n=6$), such as teachers or families. To this extent, one participant mentions the design of "products which better match the individual's strengths", highlighting not only the concern with user involvement but also the usage of non-ableist language. The importance of interdisciplinarity ($n=1$) and inclusive prototyping workshops ($n=1$) was also mentioned.

The thematic map (Figure 4) shows the two main areas in need of further scientific development, namely specific fields of themes, and the adoption of inclusive and participatory approaches. Moreover, a conceptual connection between the two is hypothesized, considering that the topics listed can also be explored through this participatory lens in which people with ID and other stakeholders are considered an active part of the knowledge-building process.

Other needs

In terms of other actions that could support the inclusion of people with ID and on the Autism Spectrum, the greatest emphasis was placed on the need to change existing technological development paradigms ($n=11$). In this context, it was unanimously felt that these changes should be based on greater

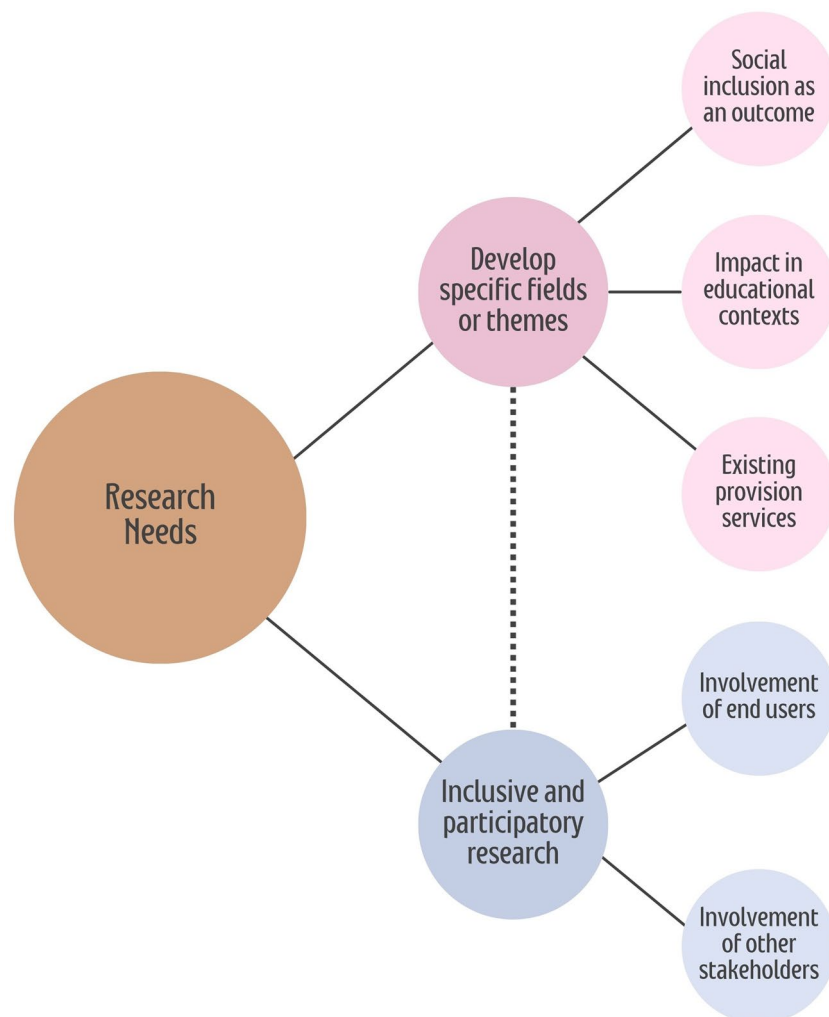


Figure 4. Thematic map of the research needs identified by the participants. Source: Authors' elaboration.

involvement of the different stakeholders in the processes ($n=11$), through participatory approaches. There were also mentions of the importance of multidisciplinary ($n=3$), universal design ($n=2$), design thinking ($n=2$), and the use of playful and gamified approaches ($n=2$). At the same level, the training of the different stakeholders ($n=11$) was also considered, including families, teachers and health professionals. Here, the need to modernize higher education courses in areas such as medicine, psychology and social work was mentioned a lot.

Participants also felt that there is an emerging need for bridging the gap between academia and civil society ($n=10$). This includes a commitment to open access ($n=6$), which is also seen as a way of resolving the lack of affordability of ATs for these populations, as a participant mentioned: “maintaining open hardware and free software-based AT”. In addition, the need to create networks with specialized institutions ($n=5$), which facilitate community involvement, and with policy-makers ($n=1$) is also mentioned.

More systemically, the participants objected to the need for changes in policies and state support ($n=7$), especially in terms of increased investment and funding ($n=7$), but also in terms of changing the pedagogical paradigm towards inclusive education ($n=1$).

Other emerging themes included the need to develop actions to raise awareness of the importance of ATs in the daily lives of autistic people and/or those with ID ($n=5$), the development of standardized provision services procedures ($n=3$), the promotion of the long-term sustainability of research and innovation projects ($n=2$), and the adaptation of interventions to the participants and/or their cultural context ($n=1$). The conceptual organization of the main emerging themes approached regarding other needs to support the use of ATs by these populations is represented in Figure 5.

Future scenarios

Considering the scenarios, it is possible to mention that there is a lot of overlap, and the result of the analysis cannot be considered mutually exclusive, but more as different facets of a grand vision of a more inclusive future, supported by ATs, for people with ID and on the Autism Spectrum. To this extent, the scenarios where specific ATs had positive outcomes for these populations were the most mentioned ($n=22$), followed by scenarios where social inclusion is seen as the central outcome ($n=20$). The full results, as well as examples of some of the scenarios created under each emerging theme, are illustrated in Table 2.

Proposed thematic model

After reviewing the thematic maps previously presented and operationalizing them concerning the research question, according to the methodology proposed by Braun & Clarke (31), it was possible to generate a more macro conceptual organization, related to future directions for research on ATs for people with ID or on the Autism Spectrum (Table 3).

In the final thematic model, the importance of investigating the life contexts of people with ID and on the Autism Spectrum is emphasised as a priority for future research. Here, five sub-themes are listed which include:

- existing barriers to independent living;
- stigma and prejudice in society, in which the prevalence of segregating models in education in some national contexts is emphasised;
- lack of accessibility, prioritizing communicational accessibility and reasonable adaptations to written texts and

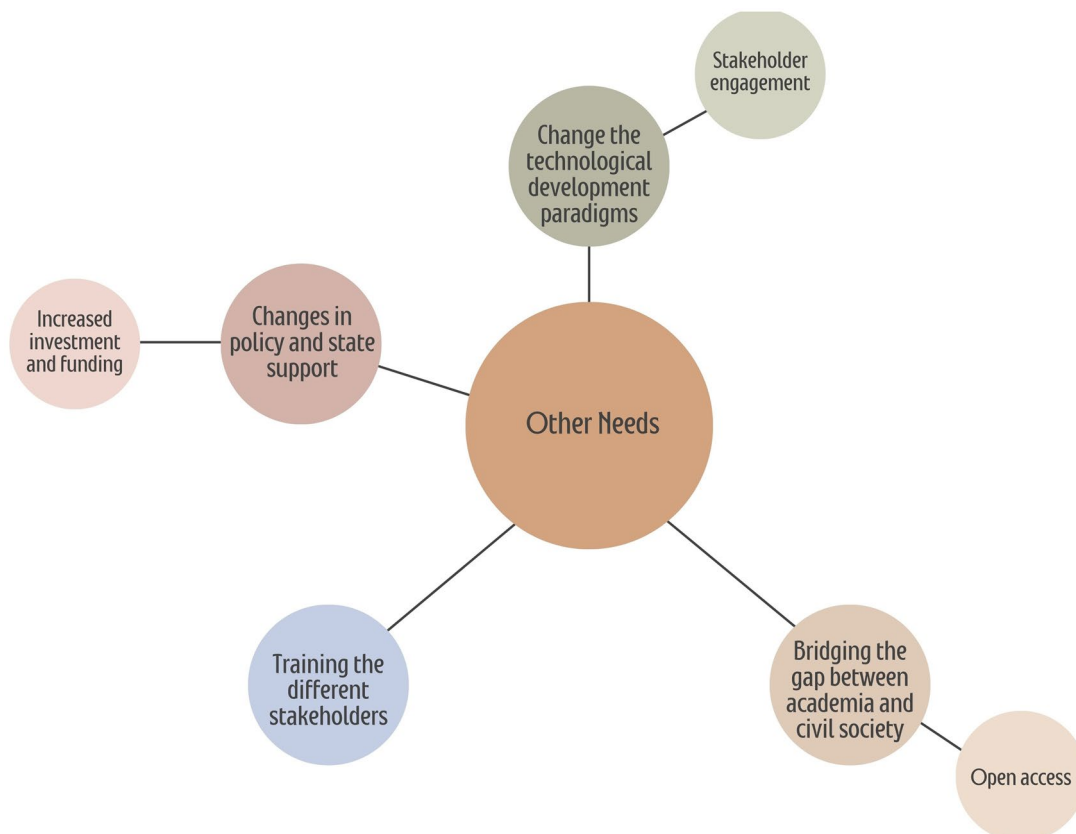


Figure 5. Thematic map of the other needs identified by the participants. Source: Authors' elaboration.

Table 2. Emerging themes, considering the future scenarios created by participants ($N=24$).

Themes of the scenarios	<i>n</i>	Citation examples
Specific ATs and their outcomes	22	"Mobile devices and EEG help communicate with individuals with ASD/ID without spelling a word." "A smart bot aids the emotional and communication skills for personal assistance of individuals with ASD."
Social inclusion	20	"Multisensory experiences help interaction between everyone." "Sports competitions and games for children (without and with disabilities)."
Employment and/or education	18	"Jan guides tourists in Bruges with the help of his voice computer." "A thriving business and the most delicious food in the restaurant (opened by people with ASD and ID)."
Macro-level changes	6	"More investments in education and healthcare – facilities, devices, research, training." "Active and standardised inclusion policies in each school and each country."
Accessibility	5	"Inclusive public transport! A diversity of people enjoy their chat on the train, accompany each other with stairs or lifts and use intuitive smartphones to guide themselves through public transport!" "Free software running on smartphones and tablets circumvents the need for expensive communication boards and finally makes AT accessible to the whole of humanity."

Table 3. Final thematic map of the future research priorities.

Themes	Subthemes
Research the life contexts of people with ID and on the Autism Spectrum	<ul style="list-style-type: none"> • Barriers to independent living • Stigma • Lack of accessibility • Existing provision services and assessment of AT usage • Integration of an intersectional lens
Action-research regarding ATs systemic support structures	<ul style="list-style-type: none"> • Awareness raising • Adequate training • Policy-driven changes • Developing AT with autistic people and/or those with ID
Research the feasibility and validity of adopting more inclusive and democratizing paradigms	<ul style="list-style-type: none"> • In research • In technological development processes • Open access dissemination and distribution

visual representations to accommodate the needs of these individuals;

- exploration of the existing provision services and assessment of AT usage, namely to explore potential hindrances in the process of matching each individual with one or more assistive systems;
- investigation of intersectionality issues associated with AT provision and usage, which can include socioeconomic condition, and cultural context, among others.

Another thematic area is represented by the need to develop action-research regarding ATs' systemic support structures. In this context, action research is understood as having an agenda for social change, as postulated by Burnes (29), containing within it the need to raise awareness, train all the stakeholders involved and generate evidence to support structural and policy changes.

Discussion

The presented study aimed to explore the perspectives on social inclusion for people with ID and those on the Autism Spectrum through the prism of ATs. The gathered and analysed data, based on the insights from the expert consultation, highlighted several challenges and needs, tracing a clearer path for the future research priorities in this field.

The biggest challenges for the social inclusion of pwID and on the Autism Spectrum – gathered through the thematic analysis of experts' perceptions – are related to the lack of communication and physical accessibility, awareness of the needs of those people and adequate training for specialists in the educational sector. In this sense, the present study is aligned with a previous study that also analysed perceptions of professionals in the field – namely occupational therapists – regarding accessibility as one of the main factors determining the abandonment of ATs by people with a broad range of support needs (37). Going one step further, our

research is also aligned with a vision of ATs as instrumental to the realisation of the CRPD – postulated by (38) – underpinning cognitive and motor accessibility as a challenge and priority for the future in this area. Moreover, it also reinforces the results from other empirical studies that show a pressing need for an increased awareness of the relevance of ATs for the social inclusion and empowerment of pwID and autistic individuals (39), demonstrating how this need is corroborated by different stakeholders, including professionals and experts in the field.

In addition, the obtained results also explore how there is still stigma in society which leads to barriers to seeking assistance, specifically on the part of families. In this sense, our study provides empirical and in-depth data that reinforces ATs as a mechanism for accommodating cognitive differences that reinforces social inclusion and acceptance of neurodiversity, reducing stigma, as supported by Boyd (40).

By prioritizing communicational and physical accessibility, challenging stigma through awareness initiatives, increasing understanding of specific needs, providing relevant and practical training in educational settings and securing state support, there will be a more accommodating social setting for people with ID and on the Autism Spectrum. The current challenges associated with the use of ATs highlight interrelated issues, encompassing limited access to both ATs and training programs, along with a deficiency in awareness and requisite skills to facilitate their effective utilization. Furthermore, the study identified the lack of more widespread adoption of participatory design in the design of accessible technologies – in particular ATs – as one of the biggest shortcomings. In this sense, and despite identifying several recent good practices such as those by El Shemy et al. (41,42) in Augmented Reality (AR) and autistic people, or those by Hsieh et al. (43) using eye-gaze, they have yet to reach the mainstream of technological development processes, so that the needs of these people are truly represented in the technologies developed. The need for an increased participation also includes the need to increase family involvement, therefore ensuring access,

affordability, heightened awareness, comprehensive skills, active involvement and customization – all crucial areas for the engagement of pwID and those on the Autism Spectrum across various life areas, including home, society and school.

In terms of the needs, outlined by the experts, the primary research focus lies in scientific development within specific fields. This entails exploring themes such as AT provision services, social inclusion and the impact on educational environments. Additionally, there is a recognized need for the adoption of inclusive and participatory approaches. This requires the active involvement of end users and other stakeholders to ensure comprehensive perspectives and effective outcomes. Other needs include changes in existing paradigms directed to technological development. In this context, these changes should be based on greater participation of diverse stakeholders throughout the processes. There should be increased investment and funding in key sectors to support neurodivergent individuals. This endeavour requires a thorough policy framework that aligns with the long-term objectives of governments to foster inclusivity and the well-being of those people. Through the strategic distribution of resources, governments can enhance accessibility to specialized healthcare, educational services and community support initiatives specifically designed for the distinct needs of those with ID or on the Autism Spectrum. Effective policies will not only improve the overall quality of life for these individuals but also stimulate research and innovation in interventions and therapies. Collaboration with relevant stakeholders, such as healthcare professionals, educators and advocacy groups, is essential to ensure that policies are shaped by the most recent research findings and best practices. Those research findings can be done by academia and bridging the gap between academia and civil society could be accomplished through open-access dissemination and distribution. In this way, a more supportive and inclusive environment that empowers individuals with ID and on the Autism Spectrum could be created.

Limitations and future directions

Although the current qualitative research includes a sample from a majority of countries around Europe, a more diverse representation, particularly from Western Europe and around the world is needed. In addition, the voices of pwID and those on the Autism Spectrum the voices of these communities have been absent. This oversight hinders the development of thorough strategies that cater to the diverse needs of all those individuals. Furthermore, inclusion in employment and education is prioritized in comparison to cultural inclusion. The latter may lag behind due to a lack of awareness, resources or tailored strategies. Focusing on employment and education is essential, but it is equally imperative to adopt a holistic view of individuals. This perspective aligns with the biopsychosocial model, recognizing that inclusion is not limited to professional and educational spheres. Cultural inclusion, encompassing psychosocial and physical activities, is an integral part of the equation. Future directions could emphasize on addressing these gaps so that society can cultivate a more inclusive and supportive environment that truly caters to the holistic well-being of every individual, fostering a sense of belonging and equality for all.

Acknowledgements

This publication is based upon work from COST Action a-STEP (CA19104), supported by COST (European Cooperation in Science and Technology).

Disclosure statement

The authors report there are no competing interests to declare.

Funding

The authors would like to acknowledge the funding and networking support by the COST Action a-STEP: advancing Social inclusion through Technology and Empowerment – CA19104 (www.a-step-action.eu), supported by COST (European Cooperation in Science and Technology; www.cost.eu).

Notes on contributors

Carla Sousa is a Psychologist with a PhD in Communication Sciences. Her main research targets are directed toward media studies, with a particular focus on games, inclusion, behavior, learning, and human diversity. In Lusófona University (Portugal), Carla is part of CICANT, and also teaches in the Degrees in Psychology and Videogames.

Paulina Tsvetkova earned her Ph.D. in Developmental and Pedagogical Psychology in 2022. She is certified in Python programming and Artificial Intelligence. Since 2019 she has worked at the Institute of Robotics, Bulgarian Academy of Sciences and has been an assistant professor at the University of Library Studies and Information Technologies in Sofia since 2022. Dr. Tsvetkova has contributed to various EU and national projects.

Patricia Pérez-Fuster is an Assistant Professor at the Department of Developmental and Educational Psychology and a member of Adapta Lab (at IRTIC) and Atypical (at ERI-Lectura) at the Universitat de València. Her research focuses on the design and implementation of technology-mediated interventions aimed at autistic people with intellectual disability.

May Agius is a Senior Speech and Language Therapist specializing in augmentative and alternative communication (AAC) and a Visiting Senior Lecturer at the University of Malta. With a PhD from Manchester Metropolitan University, her research focuses on AAC interventions for autistic children.

Snezhana Kostova is an Associate Professor at the Institute of Robotics-BAS. Her research focuses on robotics, control systems, and applied mathematics, with a particular interest in social robotics in education.


Karolina Bolesta is a Senior IT Manager at Procter & Gamble and is completing her PhD in Quantitative Economics, focusing on technological change in the labor market. She also serves as an AI Expert at the Chancellery of the Prime Minister of Poland.

Flávia Megda Garcia is a medical doctor and researcher at the Núcleo de Pesquisa em Vulnerabilidade e Saúde (NAVES) at the Universidade Federal de Minas Gerais. Her work focuses on mental health, social vulnerability, and the development of strategies to support individuals in challenging health contexts.

Benjamin Nanchen has been a scientific collaborator at the Institute of Tourism of the University of Applied Sciences Western Switzerland (HES-SO) since September 2016. Since 2019, he has been the manager of the Living Lab for Special Needs. His research interests focus on vulnerable consumers, especially consumers with disabilities, consumer empowerment, inclusive design, and co-innovation approach.

Alan H. Tkaczyk is an Associate Professor at the University of Tartu, specializing in computational modeling, machine learning, and technological solutions for social inclusion. With a PhD from the University of Michigan, he has led research on numerous European Union Horizon and Estonian projects.

ORCID

Carla Sousa  <http://orcid.org/0000-0003-1036-963X>
 Paulina Tsvetkova  <http://orcid.org/0000-0001-5637-1925>
 Patricia Pérez-Fuster  <http://orcid.org/0000-0001-6525-9847>
 May Agius  <http://orcid.org/0000-0003-2719-7301>
 Snezhana Kostova  <http://orcid.org/0000-0002-9274-9611>
 Karolina Bolesta  <http://orcid.org/0000-0002-9668-5782>
 Flávia Megda Garcia  <http://orcid.org/0000-0003-0809-8471>
 Benjamin Nanchen  <http://orcid.org/0000-0003-0552-7912>
 Alan H. Tkaczyk  <http://orcid.org/0000-0002-9006-9321>

References

- [1] Legault M, Bourdon JN, Poirier P. From neurodiversity to neurodivergence: the role of epistemic and cognitive marginalization. *Synthese*. 2021;199(5-6):12843–12868. doi: [10.1007/s11229-021-03356-5](https://doi.org/10.1007/s11229-021-03356-5).
- [2] Robertson SM. Neurodiversity, quality of life, and autistic adults: shifting research and professional focuses onto real-life challenges. *DSQ*. 2009;30(1). doi: [10.18061/dsq.v30i1.1069](https://doi.org/10.18061/dsq.v30i1.1069).
- [3] García TP, Scherer M, Jiménez E, et al. Improving assistive technology services through outcome measures and global knowledge sharing in order to make the best match of person and technology. In Layton N, Borg J, editors. *Global perspectives on assistive technology*. Geneva, Switzerland: World Health Organization; 2019. p. 233–247.
- [4] Sonuga-Barke E, Thapar A. The neurodiversity concept: is it helpful for clinicians and scientists? *Lancet Psychiatry*. 2021;8(7):559–561. doi: [10.1016/S2215-0366\(21\)00167-X](https://doi.org/10.1016/S2215-0366(21)00167-X).
- [5] Baron-Cohen S. Editorial perspective: neurodiversity—a revolutionary concept for Autism and psychiatry. *Child Psychol Psychiatry*. 2017;58(6):744–747. doi: [10.1111/jcpp.12703](https://doi.org/10.1111/jcpp.12703).
- [6] Thomson A, Goberman-Hill R. Equality, diversity and inclusion: key definitions. In Thomson A, Goberman-Hill R, editors. *Nurturing equality, diversity and inclusion*. Bristol, United Kingdom: Policy Press; 2024. p. 5–32. doi: [10.51952/9781447368014.ch001](https://doi.org/10.51952/9781447368014.ch001).
- [7] American Psychiatric Association. *Diagnostic and statistical manual of mental disorders: DSM-5*. Washington, DC: American Psychiatric Publishing; 2013.
- [8] Constantino CD. What can stutterers learn from the neurodiversity movement? *Semin Speech Lang*. 2018;39(4):382–396. doi: [10.1055/s-0038-1667166](https://doi.org/10.1055/s-0038-1667166).
- [9] Dunn DS, Andrews EE. Person-first and identity-first language: Developing psychologists' cultural competence using disability language. *Am Psychol*. 2015;70(3):255–264. doi: [10.1037/a0038636](https://doi.org/10.1037/a0038636).
- [10] Derks S, Willemen AM, Sterkenburg PS. Improving adaptive and cognitive skills of children with an intellectual disability and/or Autism Spectrum disorder: meta-analysis of randomized controlled trials on the effects of serious games. *Int J Child-Comput Interact*. 2022;33:100488. doi: [10.1016/j.ijcci.2022.100488](https://doi.org/10.1016/j.ijcci.2022.100488).
- [11] Klefbeck K. Educational approaches to improve communication skills of learners with Autism Spectrum disorder and comorbid intellectual disability: an integrative systematic review. *Scand J Educ Res*. 2023;67(1):51–68. doi: [10.1080/00313831.2021.1983862](https://doi.org/10.1080/00313831.2021.1983862).
- [12] Khachadourian V, Mahjani B, Sandin S, et al. Comorbidities in autism spectrum disorder and their etiologies. *Transl Psychiatry*. 2023;13(1):71. doi: [10.1038/s41398-023-02374-w](https://doi.org/10.1038/s41398-023-02374-w).
- [13] Álvarez-Couto M, García-Villamisar D, Del Pozo A. Challenging behaviors in adults with Autism Spectrum disorder and intellectual disability: a differential analysis from a transdiagnostic approach. *J Intellect Disabil*. 2023;17446295231184116. doi: [10.1177/17446295231184116](https://doi.org/10.1177/17446295231184116).
- [14] World Health Organization. Factsheet: assistive technology; 2024. <https://www.who.int/news-room/fact-sheets/detail/assistive-technology>
- [15] Owuor J, Larkan F, Kayabu B, et al. Does assistive technology contribute to social inclusion for people with intellectual disability? A systematic review protocol. *BMJ Open*. 2018;8(2):e017533. doi: [10.1136/bmjopen-2017-017533](https://doi.org/10.1136/bmjopen-2017-017533).
- [16] Torrado JC, Gomez J, Montoro G. Hands-on experiences with assistive technologies for people with intellectual disabilities: opportunities and challenges. *IEEE Access*. 2020;8:106408–106424. doi: [10.1109/ACCESS.2020.3000095](https://doi.org/10.1109/ACCESS.2020.3000095).
- [17] MacLachlan M, Banes D, Bell D, et al. Assistive technology policy: a position paper from the first global research, innovation, and education on assistive technology (GREAT) summit. *Disabil Rehabil Assist Technol*. 2018;13(5):454–466. doi: [10.1080/17483107.2018.1468496](https://doi.org/10.1080/17483107.2018.1468496).
- [18] Simplican SC, Leader G, Kosciulek J, et al. Defining social inclusion of people with intellectual and developmental disabilities: an ecological model of social networks and community participation. *Res Dev Disabil*. 2015;38:18–29. doi: [10.1016/j.ridd.2014.10.008](https://doi.org/10.1016/j.ridd.2014.10.008).
- [19] Darcy S, Maxwell H, Green J. Disability citizenship and independence through mobile technology? A study exploring adoption and use of a mobile technology platform. *Disab Soc*. 2016;31(4):497–519. doi: [10.1080/09687599.2016.1179172](https://doi.org/10.1080/09687599.2016.1179172).
- [20] Darcy S, Green J, Maxwell H. I've got a mobile phone too! Hard and soft assistive technology customization and supportive call centres for people with disability. *Disabil Rehabil Assist Technol*. 2017;12(4):341–351. doi: [10.3109/17483107.2016.1167260](https://doi.org/10.3109/17483107.2016.1167260).
- [21] Den Brok WL, Sterkenburg PS. Self-controlled technologies to support skill attainment in persons with an Autism Spectrum disorder and/or an intellectual disability: a systematic literature review. *Disabil Rehabil Assist Technol*. 2015;10(1):1–10. doi: [10.3109/17483107.2014.921248](https://doi.org/10.3109/17483107.2014.921248).
- [22] Nierling L, Maia, M. Assistive technologies: social barriers and socio-technical pathways. *Societies* 2020;10(2):41. doi: [10.3390/soc10020041](https://doi.org/10.3390/soc10020041).
- [23] Kim J, Kimm CH. Functional technology for individuals with intellectual disabilities: Meta-analysis of mobile device-based interventions. *The Journal of Special Education Apprenticeship* 2017;6(1):article 3. doi: [10.58729/2167-3454.1058](https://doi.org/10.58729/2167-3454.1058).
- [24] Syriopoulou-Delli CK, Gkiolnta E. Review of assistive technology in the training of children with autism spectrum disorders. *Int J Dev Disabil*. 2022;68(2):73–85. doi: [10.1080/20473869.2019.1706333](https://doi.org/10.1080/20473869.2019.1706333).
- [25] Tsaneva GG, Andreeva A, Tsvetkova P, et al. Exploring the potential of social robots for speech and language therapy: a review and analysis of interactive scenarios. *Machines*. 2023;11(7):693. doi: [10.3390/machines11070693](https://doi.org/10.3390/machines11070693).

- [26] Nanchen B, Rullac S, Fragnière E, et al. Innover avec et pour les personnes en situation de handicap. Vers une approche transdisciplinaire de co-innovation. *Alter Eur J Disab Res.* 2023;17(4):69–84.
- [27] Döringer S. 'The problem-centred expert interview'. Combining qualitative interviewing approaches for investigating implicit expert knowledge. *Int J Soc Res Methodol.* 2020;24(3):265–278. doi: [10.1080/13645579.2020.1766777](https://doi.org/10.1080/13645579.2020.1766777).
- [28] Merriam SB. *Qualitative research: a guide to design and implementation.* Hoboken, NJ: Jossey-Bass; 2009.
- [29] Burnes B. The origins of Lewin's three-step model of change. *J Appl Behav Sci.* 2020;56(1):32–59. doi: [10.1177/0021886319892685](https://doi.org/10.1177/0021886319892685).
- [30] Snyder M. In the footsteps of Kurt Lewin: practical theorizing, action research, and the Psychology of Social Action. *J Social Issues.* 2009;65(1):225–245. doi: [10.1111/j.1540-4560.2008.01597.x](https://doi.org/10.1111/j.1540-4560.2008.01597.x).
- [31] Braun V, Clarke V. Using thematic analysis in psychology. *Qual Res Psychol.* 2006;3(2):77–101. doi: [10.1191/1478088706qp063oa](https://doi.org/10.1191/1478088706qp063oa).
- [32] Braun V, Clarke V. Toward good practice in thematic analysis: avoiding common problems and becoming a knowing researcher. *Int J Transgend Health.* 2023;24(1):1–6. doi: [10.1080/26895269.2022.2129597](https://doi.org/10.1080/26895269.2022.2129597).
- [33] American Psychological Association. *Journal Article Reporting Standards for Qualitative Research in Psychology: The APA Publications and Communications Board Task Force Report.* *American Psychologist.* 2020;75(1):1–12. doi: [10.1037/amp0000191](https://doi.org/10.1037/amp0000191).
- [34] Magnone KQ, Yezierski EJ. Beyond convenience: a case and method for purposive sampling in chemistry teacher professional development research. *J Chem Educ.* 2024;101(3):718–726. doi: [10.1021/acs.jchemed.3c00217](https://doi.org/10.1021/acs.jchemed.3c00217).
- [35] Singer E, Couper MP. Some methodological uses of responses to open questions and other verbatim comments in quantitative surveys. *Methods Data Anal.* 2017;11(2):115–133. doi: [10.12758/mda.2017.01](https://doi.org/10.12758/mda.2017.01)
- [36] Saldaña J. Coding and analysis strategies. In Leavy P, editor. *The Oxford handbook of qualitative research.* Oxford, United Kingdom: Oxford University Press; 2014. p. 581–605.
- [37] Cruz D, Emmel MLG, Manzini MG, et al. Assistive technology accessibility and abandonment: challenges for occupational therapists. *Open J Occup Ther.* 2016;4(1):1–7. doi: [10.1015453/2168-6408.1166](https://doi.org/10.1015453/2168-6408.1166).
- [38] Smith EM, Huff S, Wescott H, et al. Assistive technologies are central to the realization of the convention on the rights of persons with disabilities. *Disab Rehab Assistive Technol.* 2024;19(2):486–491. doi: [10.1080/17483107.2022.2099987](https://doi.org/10.1080/17483107.2022.2099987).
- [39] Mishra S, Laplante-Levesque A, Barbareschi G, et al. Assistive technology needs, access and coverage, and related barriers and facilitators in the WHO European region: a scoping review. *Disability and Rehabilitation: assistive Technology.* 2024;19(2):474–485. doi: [10.1080/17483107.2022.2099021](https://doi.org/10.1080/17483107.2022.2099021).
- [40] Boyd L. Conceptualizing celebratory technologies for neurodiversity to reduce social stigma. In *Proceedings of the 25th International ACM SIGACCESS Conference on Computers and Accessibility;* 2024. p. 1–4. doi: [10.1145/3597638.3614478](https://doi.org/10.1145/3597638.3614478).
- [41] El Shemy I, Urrea Echeverria AL, Erena-Guardia G, et al. Enhancing the vocabulary learning skills of autistic children using augmented reality: a participatory design perspective. In *Proceedings of the 2023 Symposium on Learning, Design and Technology;* 2023. p. 87–96. doi: [10.1145/3594781.3594791](https://doi.org/10.1145/3594781.3594791).
- [42] El Shemy I, Jaccheri L, Giannakos M, et al. Augmented reality-enhanced language learning for children with Autism Spectrum disorder: a systematic literature review. *Behav Inform Technol.* 2024;1–28. doi: [10.1080/0144929X.2024.2304607](https://doi.org/10.1080/0144929X.2024.2304607).
- [43] Hsieh YH, Granlund M, Odom SL, et al. Increasing participation in computer activities using eye-gaze assistive technology for children with complex needs. *Disabil Rehabil Assist Technol.* 2024;19(2):492–505. doi: [10.1080/17483107.2022.2099988](https://doi.org/10.1080/17483107.2022.2099988).