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Technologies as a support resource for people with disabilities: a systematic review

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ABSTRACT
The increasing use of Information and Communication Technologies (ICT) has brought advances in interventions for people with disabilities. The aim of this study was to review the scientific literature of the last ten years regarding technologies as tools for improving the quality of life of people with disabilities. To this end, PRISMA methodology was used, performing a search in two different databases: Scopus and Web of Science (WoS), obtaining a final sample of 21 studies. To evaluate the risk of bias, the ROBIS tool was used, and the VOSviewer software was employed to carry out a keyword co-occurrence analysis. The main result to emerge was that the scientific literature is increasing, and that the most studied skills are those related to writing and reading. Most of the participants have intellectual disability or autism spectrum disorder move this sentence up. The scientific literature is still scarce; therefore, further research is necessary in this field, since the inclusion of ICT in the day-to-day, both in the teaching-learning process and in activities of daily living, offers new opportunities to people with disability.

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Introduction

The most recent data of the World Health Organisation (2021) show that around 15% of the world population have some type of disability, thus a considerable proportion of people all over the world are very likely to develop a disability throughout their lives, either temporarily or permanently. In this sense, the quality of life of these people is limited when they encounter physical, communication, social and economic barriers, as well as health-related problems. Consequently, people with disabilities show greater dissatisfaction with their lives, due not only to the disability itself, but also to aspects related to discrimination, prejudice and even social exclusion (Baek et al., 2022).

Therefore, it is fundamental to work on inclusion from early ages, with the educational scope being an ideal space for it. Education is the path to acquiring knowledge, integrating cultural and social values, and developing skills that facilitate the full inclusion of people in society (Fuentes

Gutiérrez et al., 2021). Thus, education systems must be primarily aimed at advocating full inclusion, helping to reduce the inequalities encountered by students with specific needs of educational support (SNES), who encounter more difficulties in learning and/or development compared to their peers. As a result, specific actions are needed to minimise and remove the barriers that may appear (Cabero-Almenara et al., 2021; Hernández Fernández & Camargo, 2022).

New methodological approaches are being currently researched to improve the teaching-learning process in ordinary classrooms; however, it is necessary to expand the research focused on the intervention for the improvement of the quality of life of people with disabilities (Jdaitawi et al., 2022). Technological tools are an interesting resource for this purpose, since today's children and young people were already born in the digital era, and thus, they are considered digital natives, which means that technologies are not foreign to them in their daily living.

According to Burke & Hughes (2018), technological resources provide opportunities to innovate, which allows transforming the teaching-learning process to cover the needs of people with disabilities. However, it is important to consider that technological devices such as Tablets and Smartphones are not exclusively designed for academic use. Therefore, special care must be taken regarding the safety of the users and the selection of specific applications or software depending on each situation.

Assistance Technology

Assistance technologies are those technological tools that are focused on supporting independence and autonomy, as well as on improving and/or maintaining the functional capacities of people with disabilities (Larco et al., 2021). Nowadays, technologies are subjected to changes and improvements, with the aim of providing different ways of interacting and learning (Gallardo Montes et al., 2021). Thus, technological resources are part of the so-called Augmentative and Alternative Communication Systems (AACS), which are mainly aimed at helping and supporting people with communication difficulties, in order to cater for their needs (Sankardas & Rajanahally, 2017). In this way, IC technologies are a potential resource for people with disabilities (Evmenova et al., 2019), since they offer novel methodological approaches and different didactic strategies that facilitate communication and interaction among all the people, regardless of their limitations (Delgado Vázquez et al., 2019).

Until recently, IC technologies and special education have been studied separately. However, there is an increasing number of studies that analyse the implementation of technological tools for people with disabilities, mitigating social exclusion through different digital resources (Lin et al., 2018). One of the main reasons for the increasing use of technologies in special education contexts is their accessibility and adaptability. Nevertheless, this is a challenge for researchers and professionals who intervene in the process, as it is important to consider several factors, such as responding to the real needs of the users, the accessibility of the device and/or software, and establishing how the user's interaction information will be obtained. Moreover, it is important to satisfy the needs of all users, that is, parents, teachers and medical specialists, always remembering that the main user is the person with a disability (Du & Salen, 2020).

Regarding the type of device, the most frequently used in these interventions are Smartphones (Putranta et al., 2021) and Tablets, as they have functions that allow changing the font size, shapes, formats, etc. Mobile devices and terminals with interactive contents are support tools for people with disabilities, since they provide independence, autonomy, participation and productivity in routine activities of daily living, academic tasks and leisure activities. This allows them to improve time management, self-esteem and empowerment, thereby fostering learning acquisition (Menezes et al., 2020; Larco et al., 2021). Although there are not many studies that address this topic, there are previous reviews that analyse the use of a specific type of technology in people with disabilities, from augmented reality (Baley et al., 2022) to the artificial intelligence (Hopcan et al., 2022).

The main objective of this study was to review the scientific literature about the use of mobile applications in people with disabilities, based on the following research questions:
Q1. What is the state of the scientific literature in the last ten years?
Q2. What type of methodology predominates in the studies?
Q3. Which countries stand out in this type of research?
Q4. Which skills are worked on with the application of technologies?
Q5. Which type of disability predominates in the participants of the studies?
Q6. In what age range were the research experiences carried out?

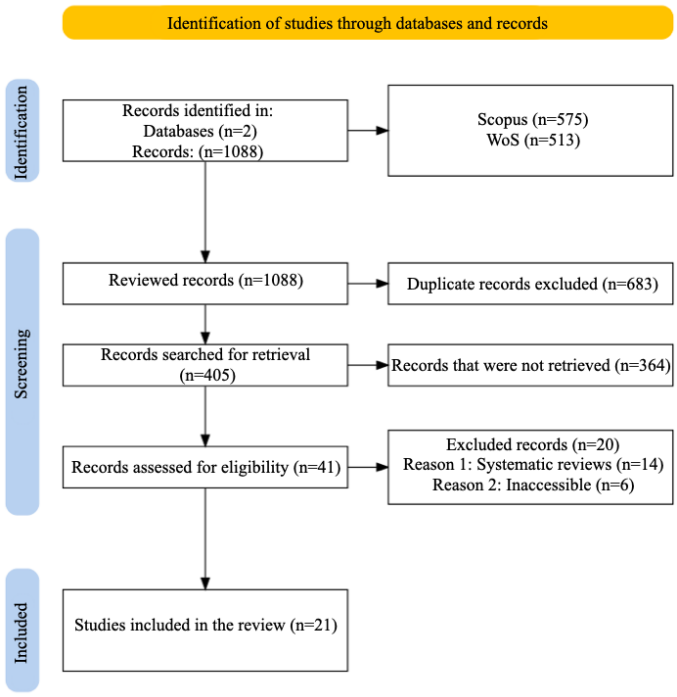
Method

Search Strategy

To attain the objectives set, the 2020 PRISMA declaration was used (Page et al., 2021). The search for articles by the researches was conducted in October and November 2022 in two databases, Scopus and WoS. These databases were selected based on the fact that they are very complete data sources that gather impact publications, with both of them being powerful tools for systematic reviews (Pranckutė, 2021). As a search strategy, the following keywords were used: apps, ict, software, disability, disabilities. The Boolean operators "AND", "OR" and "NOT" were employed in the different searches performed. A total of 1,088 records were identified (575 in Scopus and 513 in WoS). After a first reading of the title and summary of the documents, we proceeded to eliminate duplicate records (683) and documents not retrieved (364) because they were considered not very relevant studies. After then excluding systematic reviews (20) and documents that could not be accessed in their entirety (6), we obtained a final sample of 21 studies after screening (Figure 1) for their exhaustive analysis. For greater validity and reliability of the study, this process was carried out by the three authors of this text after a consensus was reached.

Figure 1

Flow Diagram of the Article Selection Process



Note. Developed by author from Haddaway et al. (2021), https://estech.shinyapps.io/prisma_flowdiagram/

Inclusion and Exclusion Criteria

Next, we present the inclusion and exclusion criteria established for the present study:

- CI1: Studies published in the last ten years (2012-2022).
- CI2: Type of document: article.
- CI3: Discipline: Social Sciences.
- CI4: Accessible documents.
- CI5: Studies that have carried out experiences with technological resources.

Various types of documents were excluded, such as doctoral theses, book chapters and conferences, as well as those that did not belong to the established scope or period. Similarly, this systematic review excluded those documents that could not be accessed and studies that were not focused on experiences, such as systematic reviews or other types of research.

Findings

Table 1 contains the 21 studies included in the review, which gathers their authors in alphabetical order, the publication year, country and database in which they were selected.

Studies Included in the Systematic Review

Table 1

Studies Selected

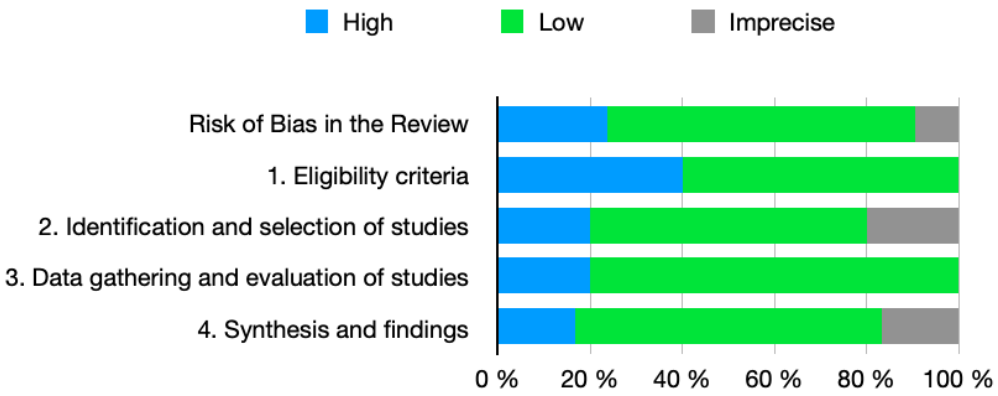
Nº	Author	Year	Country	Database
1	Alqahtani	2020	USA	WoS
2	Alqahtani	2021	USA	WoS
3	Balint-Langel et al.	2022	USA	Scopus
4	Bassette et al.	2019	USA	WoS
5	Beccaluva et al.	2022	Italy	Scopus
6	Camacho-Conde & Magán-Alvite	2021	Spain	WoS
7	Chai et al.	2016	USA	Scopus
8	Cook & Sayeski	2020	USA	Scopus
9	Fage et al.	2019	Belgium	Scopus
10	Fage et al.	2020	France	WoS
11	Hampshire et al.	2022	USA	Scopus
12	Jdaitawi et al.	2022	Saudi Arabia	Scopus
13	Kennedy et al.	2020	USA	Scopus
14	Matulewski et al.	2022	Poland	WoS
15	Mazzotti et al.	2022	USA	Scopus
16	McMahon et al.	2013	USA	WoS
17	Misquitta & Ghosh	2021	India	Scopus
18	Pitchford et al.	2018	Malawi	WoS
19	Romski et al.	2022	South Africa	Scopus
20	Williams & Shekhar	2019	UK	WoS
21	Zhang et al.	2015	USA	WoS

The quality of the studies included in the final sample was analysed by the authors using the ROBIS tool to evaluate the risk of bias (Whiting et al., 2016). This tool evaluates four domains: eligibility criteria of the study, identification and selection of studies, data gathering, and synthesis

and findings. Each domain contains questions that measure the risk of bias, classifying it as high, low or imprecise. Figure 2 presents the general evaluation with ROBIS, which showed that over 60 % of the results contain a low risk of bias.

Figure 2

ROBIS



Note. Developed by author after applying the tool

Status of Scientific Production in the Last 10 Years

Tthe analysis of the reviewed studies shows that most of the these are concentrated in the years 2022 (33.3 %), 2020 (19 %), 2021 (14.3 %), and 2019 (14.3 %). On the other hand, few studies were published in the years 2013, 2015, 2016 and 2018 (4.8 %), and no studies were selected from the years 2017, 2014 or 2012.

Predominant Type of Methodology

With regard to the type of methodology used in the studies, with the quantitative methodology standing out (47.6 %), followed by mixed methods (28.6 %) and qualitative methods (23.8 %).

Main Countries of Investigation

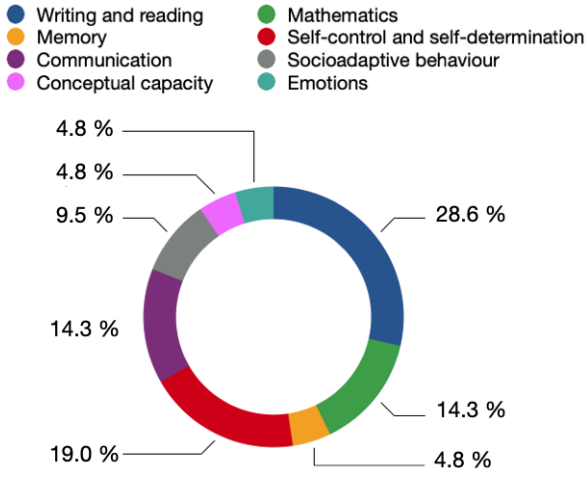
Regarding the countries where the studies were conducted, USA stands out by far, with 11 studies (52 %). The remaining 48 % of the studies were carried out in different countries: Spain, Italy, Belgium, France, Saudi Arabia, India, UK and South Africa.

Experiences with Technology in People with Disabilities: Skills addressed in the Studies

Figure 3 shows the skills that have been most frequently tackled in the studies, with those related to writing and reading appearing in greater proportion (28.6 %), followed by self-control and self-determination (19 %), mathematics (14.3 %), communication skills (14.3 %) and socio-adaptive behaviour (9.5 %). To a lesser extent, skills associated with memory (4.8 %) and emotions (4.8 %) have also been addressed.

Figure 3

Areas Approached in the Studies



Among the different studies reviewed, Misquitta & Ghosh (2021) highlight the importance of literacy to obtain better opportunities in life, hence the relevance of working on skills related to writing and reading, especially in people with disabilities, since they usually have limitations and deficiencies in this sense. Thus, authors such as Hampshire et al. (2022), Kennedy et al. (2020) and Chai et al. (2016) have addressed phonological, writing and vocabulary skills in their studies. Alqahtani, in two studies (2020 and 2021), shows that reading comprehension skills improved significantly after working with the iPad in participants with intellectual disability (ID).

Communication skills are strongly related to writing and reading skills, and they have been tackled by Camacho-Conde & Magán-Alvite (2021), Romski et al. (2022) and Matulewski et al. (2022), among others, who delved into new ways of communication using a software for people with disabilities, with all of them showing satisfactory results.

Using the same device (iPad), Balint-Langel et al. (2022) addressed self-control, reporting promising results, since the participants of their study learned to operate the device, although they recommend constant work to attain better results. Mazzotti et al. (2022) focused their research on self-determination, whereas Cook & Sayeski (2020) investigated the efficacy of a tool to work on the self-control of high-school students with disabilities in ordinary classrooms, stating that further studies are needed in this regard. In a sample of elementary students with autism spectrum disorder (ASD), Bassette et al. (2019) and Zhang et al. (2015) worked on mathematical skills regarded as fundamental in daily living for task execution and problem solving. The results showed greater fluidity in different tasks after working on an application.

Memory was also investigated, especially in people with intellectual disability. Beccaluva et al. (2022) suggest that not only is it positive to work with technological resources to foster these skills, but their collaborative use provides even more benefits. Fage et al. (2019) addressed emotions in adolescents with ASD and ID, reporting promising results. Thus, the main results showed that children equipped with ASD improved their socio-adaptive behaviours and social responsiveness in the school environment. Both groups improved their socio-cognitive functioning.

Adaptive behaviour has been studied by Fage et al. (2020), since the inclusion of ASD students in the classrooms is frequently hindered by their adaptive difficulties. After the intervention with a mobile application, the results showed a general improvement in the adaptive behaviour of the participants.

Type of Disability of Study Participants

The type of disability of the participants of the selected studies was very diverse. The most frequent disability was ID (33 %) and ASD (33 %). A total of 19 % of the studies were conducted in people with different types of disabilities (auditory, motor, visual or mental). To a lesser extent, the participants had developmental disorders (10 %) and language deficiencies (5 %). According to the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), ID is a disorder that includes both intellectual and adaptive behaviour deficiencies that appear during development. A large proportion of the analysed studies were conducted in people with ID. All this influences different scopes: cognitive, social, communication, motor, behavioural and emotional.

Another considerable number of studies in the sample of this systematic review were carried out in people with ASD. This disorder is mainly characterised by difficulties in communication. The DSM-5 defines it as a set of persistent communication deficiencies, as well as deficiencies in social interaction. It includes deficiencies in socio-emotional reciprocity, relations and communication behaviours, with ASD people presenting repetitive patterns of behaviours, activities and interests.

In this regard, technology has a potential use in people with ID, who can learn to operate different devices and thus alleviate difficulties of daily living (Balint-Langel et al., 2022). As in other types of disabilities, technology may pose a support in people with ASD to work on different skills and therefore make their lives easier (Bassette et al., 2019).

Age Category

Regarding the target age range of the studies, the range of 7-12 years stands out (47.6 %), followed by the range of 13-18 years (23.8 %), young adults aged 19 to 30 years (19 %) and, lastly, the early ages of 0 to 6 years (9.5 %).

Quality of Life of People with Disabilities

The world presents many difficulties and barriers to people with disabilities and their families. In this sense, educational centres do not always have the necessary resources to cover the real needs of their students with disabilities. In this respect, technologies provide innovative opportunities that may grant benefits to this population (Hampshire et al., 2022). For example, being able to operate communication systems that allow interacting with other people improve the quality of life of the users of such systems. In some cases, the key is not to use too many resources and excessive costs, but learning to use new tools that allow improving the quality of life of users with disabilities (Matulewski et al., 2022).

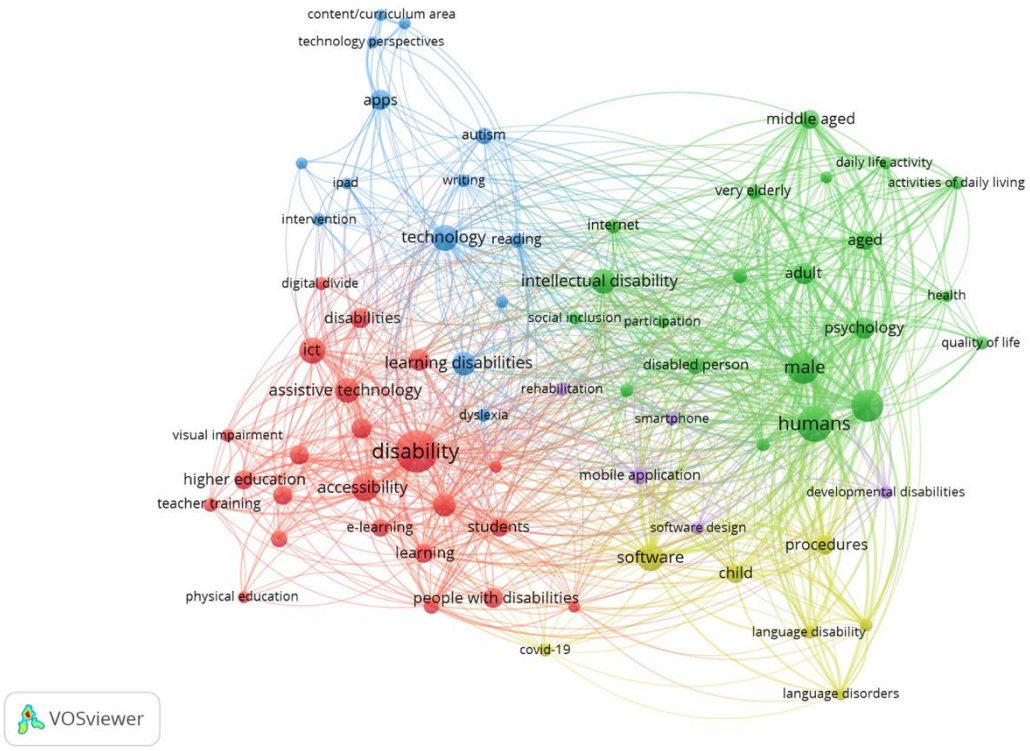
Williams & Shekhar (2019) analysed the usability of mobile devices, specifically the interaction with screens (touching, sliding and using buttons). The results showed that most of the users succeeded in the use of these devices; however, different difficulties emerged, thus more research must be carried out in this line to further improve the quality of life of people with disabilities. All the studies in this field are carried out with the aim of improving their quality of life not only at school, but also in the transition to the adult and work life (Balint-Langel et al., 2022).

Analysis of Keyword Co-occurrence

The keyword co-occurrence of the search performed was conducted automatically using the VOSviewer programme. Figure 4 shows a map with the main keywords detected, classified in thematic nodes or clusters. The size, colour and distance between them indicate the relationship between the different terms, as well as their frequency of appearance.

Figure 4

Map of Thematic Nodes or Clusters



Note. Developed by author after applying the tool

- **Cluster 1:** The first cluster consists of 24 items and is represented in red. It refers to the main theme of the studies with the following keywords: accessibility, assistive technology, digital divide, disabilities, disability, e-learning, education, higher education, ICT, inclusion, inclusive education, information and communication technologies, learning, motivation, people with disabilities, physical education, special education, students, students with disabilities, teacher training, teaching, visual impairment, web accessibility.
- **Cluster 2:** The second cluster consists of 21 items and is represented in green. Mainly, it refers to the target people of the studies, with the following terms: activities of daily living, adolescent, adult, aged, daily life activity, disabled person, female, health, humans, intellectual disability, intellectual impairment, internet, male, middle aged, participation, perception, physical activity, psychology, quality of life, social inclusion, very elderly.
- **Cluster 3:** The third cluster gathers 14 items, represented in blue, which refer to both the types of disabilities and the technology used in the experiences of the studies, with the following keywords: apps, autism, content/curriculum area, dyslexia, exceptionality, intervention, iPad, learning disabilities, mathematics, mobile apps, reading, technology, technology perspective, writing.
- **Cluster 4:** The fourth cluster consists of 7 items and is represented in yellow. These terms are less strongly related to the rest: child, covid-19, language disability, language disorders, preschool child, procedures, software.
- **Cluster 5:** The fifth and last cluster only includes 5 items, represented in purple. This cluster shows the keywords that appear less frequently in the analysed studies: developmental disabilities, mobile applications, rehabilitation, smartphone, software design.

Discussion and Conclusions

The aim of this systematic review was to analyse interventions with technological tools through experiences carried out in people with disabilities. Taking into account all the analysed studies and recovering the questions proposed at the beginning of this review, it can be asserted that, regarding the first question (Q1), the scientific literature seems to be increasing, which means that interventions with technological tools in people with disabilities is a topic of increasing interest in many studies (Jdaitawi et al., 2022; Mazzotti et al. 2022). With regard to the type of methodology used in the studies (Q2), the quantitative approach stands out over the qualitative approach. Pitchford et al. (2018) considers quantitative contributions in this type of studies very necessary The country with the largest number of publications in this topic (Q3) is, by far, USA.

All the analysed studies are focused on a specific skill or capacity (Q4), with the aim of improving the experience of the user and, therefore, his/her quality of life in all cases. Many of these studies have indirectly aimed to work on autonomy, which is a fundamental aspect that is intended to be improved in the interventions in people with disabilities (Balint-Langel et al., 2022). This is very important in the transition to the adult life, since, in the labour scope, merely one third of people with disabilities find employment, and their jobs are usually precarious, especially in the case of people with intellectual disability (Alqahtani, 2020). The skills related to communication and social interaction have also been the focus of the analysed studies. Romski et al. (2022) suggest that the guided use of mobile applications improve oral language and, consequently, communication in children with different disabilities. Moreover, self-control is another fundamental element in terms of self-management strategies (Cook & Sayeski, 2020) and, thus, many studies have been focused on it.

The most frequent type of disability among the participants of the studies (Q5) was intellectual disability, hence the importance of working on the previously mentioned skills, since these are the ones in which they encounter more difficulties and limitations. Lastly, regarding the age of the participants (Q6), the range of 7-12 years stands out, as working from early ages is considered fundamental for the diagnosis and treatment in order to attain more significant and long-lasting improvements (Beccaluva et al., 2022).

Therefore, the use of digital tools poses an advance in the quality of life of people with disabilities. For instance, Fage et al. (2019) show that it can improve the self-regulation of emotions in adolescents with ASD after working with a mobile application. Augmented reality (AR) is also a good ally in this respect, as it allows children with disabilities to better understand concepts. This was demonstrated by Jdaitawi et al. (2022), who, after implementing an AR strategy, observed improvements in self-regulation in the participants; consequently, they suggest using it in the scope of special education after verifying its effectiveness.

However, there continues to be a predominance of studies that analyse the effects of technology to make people's lives easier (Deveci, 2023), and for students of ordinary classrooms over students with disabilities, which is partly due to the difficulty, effort and cost of applications designed for interacting with gaze (Matulewski et al., 2022; Pitchford et al., 2018).

This systematic review has some limitations, such as the terms used for the search, the databases employed, and the small number of articles selected. Although the keywords used were agreed on by the authors, it is recommended to extend the terminology and the databases for future studies, in order to expand the results. Despite the fact that most of the results of the analysed studies are satisfactory, it is important to consider that the sample is usually small, thus the results cannot be generalised. Therefore, it is recommended to increase the sample of participants, as well as the types of disabilities (McMahon et al., 2013). However, without a doubt, these experiences will demonstrate whether the designed and used technological tools are correct or require modifications for future interventions (Pitchford et al., 2018).

This systematic review has shown that studies focused on improving the quality of life of people with disabilities through technologies are scarce. However, in all the research included in this review, the need to continue experimenting in this line is highlighted, since it is clear that technologies

are part of our daily lives and can be used as a support resource to achieve full inclusion in society of people with disabilities (Hampshire et al., 2022). As a recommendation for future studies similar to this one, the databases for the search of articles can be expanded, as well as replicating the study continuously focusing on recent years, since the advance of technologies makes new tools emerge and/or change constantly.

To conclude, and as was stated by Hampshire et al. (2022), "what we do with our time and talent may change lives" (p. 8).

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