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Assistive technology for the inclusion of students with disabilities: a systematic review

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Abstract

The commitment to increase the inclusion of students with disabilities has ensured that the concept of Assistive Technology (AT) has become increasingly widespread in education. The main objective of this paper focuses on conducting a systematic review of studies regarding the impact of Assistive Technology for the inclusion of students with disabilities. In order to achieve the above, a review of relevant empirical studies published between 2009 and 2020 in four databases (Web of Science (WoS), Scopus, ERIC and PsycINFO) was carried out. The sample consists of 31 articles that met the inclusion criteria of this review, out of a total of 216 identified. Findings of this study include that the use of Assistive Technologies is successful in increasing the inclusion and accessibility of students with disabilities, although barriers such as teacher education, lack of information or accessibility are found.

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Introduction

In the educational field, students with disabilities face a set of barriers that limit their learning and achievement in different activities that take place in the classroom setting. It is essential that these students have access to the same opportunities to participate in society as their peers. In this context, digital technologies are a tool to access the curriculum. In this regard, evidence has shown that digital technologies (computers, laptops and mobile devices) have changed many students' lives (Bond, 2014). Despite these changes affecting education, little attention has been paid to how students with disabilities have incorporated technologies into their daily lives (Passey, 2013; European Schoolnet, 2014). This is not surprising, given that existing research on children with disabilities is scarcely developed (McLaughlin et al., 2016), while generic research often excludes this sector of the student population (Connors & Stalker, 2007). This may be a challenge in terms of ensuring equal opportunities to access and benefit from digital technologies.

This concern to ensure equality and equity is evidenced in most of the international initiatives over the past decade, for example the UNESCO-Weidong Group project "Harnessing ICTs for Education 2030" which will, over four years, support participating Member States in harnessing the potential of ICTs to achieve ODS 4 by 2030. The United Nations also adopted, during its General Assembly on 13 December 2006, the resolution drafted by the International Convention on the Rights of People with Disabilities, in order to promote measures for research and development of disability-friendly technologies and their availability and use, including specific technical devices designed to improve the daily lives of people with disabilities.

Conceptualization

"Assistive Technology" (hereinafter AT) according to the World Health Organization (WHO), is a generic term that designates all systems and services related to the use of assistive products and the performance of services (WHO, 2001). Generally and according to the Assistive Technology Act of 1998, in the U.S. it is defined as "any item, piece of equipment or system, whether acquired commercially, modified, or customized, that is commonly used to increase, maintain, or improve the functional capabilities of people with disabilities" (Buning et al, 2004, p. 98). For Lewis (1993), AT has two main purposes: on the one hand, to increase a person's capabilities so that his or her abilities balance out the effects of any disability. And second, to provide an alternative way of approaching a task so that disabilities are compensated.

AT is proposed as an alternative for the interaction between students with disabilities and new digital devices (Emiliani et al., 2011), which:

> Refers to the technologies (devices or services) used to compensate for functional limitations, to facilitate independent living, to enable older people and people with activity limitations to realise their full potential. Some technologies, even if not purposely designed for people with activity limitations, can be configured in such a way as to provide assistance or assistive functions when needed. The term AT covers any kind of equipment or service capable of meeting this definition. Examples include

wheelchairs, prosthesis, communicators and telecommunication services. In eInclusion, AT includes, for example, equipment and services for access to information (e.g., for seeing, hearing, reading, writing), interpersonal communication and control of the environment. (p. 102)

AT is divided into low technologies, which do not use programming, such as magnifiers and pencil holding devices, and high technologies, which use programming, such as computers (McCulloch, 2004). Authors such as Cook and Hussey (1995) and Bryant & Crews (1998) also classify AT into two types: low or simple technology and high and complex technology. Low or simple technology has been described as equipment that is most often low cost and easy to create or obtain. These require a simplified process for operation (pencils, calculator loupes, paper communication boards, wheelchairs, etc.). Complex technology concerns equipment that has electronic technology (computers, electronic communication boards, electric wheelchairs, etc.).

To understand the role of AT regarding people with disabilities, it becomes necessary to review the concept of disability as well. In this regard, it must be said that disability has had different readings depending on the era and the predominance of health models. The contexts have been varied and even complementary, so explaining disability is a difficult task. The International Classification of Functioning, Disability and Health (ICF), published by the World Health Organization (WHO, 2001), is a bridge between the medical and social models, since it understands disability as the interrelationship between a person's health condition and the environmental factors that affect his/her lifestyle. Thus, disability is understood as the circumstance of negative aspects of the individual's interaction and its contextual factors, activity limitations and participation barriers. In the traditional medical model, a "disability" is defined as any form of impairment or limitation placed on an individual's normal functioning, so "impairment" implies a reduction or weakening of normal functioning, and "limitation" implies a reduction of normal activity. In this way, we understand limitation as the multiple barriers that limit student learning and participation (Echeita, 2013).

AT is the basis for creating inclusive education systems in which students with disabilities enjoy the same training and learning as their peers who are not limited in their daily activities.

Framework

The scientific literature reports both the benefits of AT for students with disabilities and the barriers to teaching and learning processes. Regarding the possible benefits, authors such as Angelo (2000) studied how specialized technologies contribute to the development of skills that provide stimulation and support to this group of students. For Murray & Rabiner (2014), AT is able to fit instantly to a student's level and provide instant feedback for improved learning. In addition, they support students with disabilities in performing tasks or functions that they would otherwise be unable to do (Sullivan & Lewis, 2000). For their part, Nelson et al., (2013) focused on improvements in academic performance and language development. Howard-Bostic et al., (2015) conducted research on the use of Multimedia Assistive Technology (MAT), finding that these tools improve the performance of university students.

NcNicholl et al., (2019) in a systematic review of AT use for students with disabilities in higher education identified four analytical themes: AT as a facilitator of academic engagement; barriers to effective AT use can hinder academic participation; the transformative possibilities of AT from a psychological perspective; and AT as a facilitator of participation. In this regard, other studies conclude that the potential use of AT for students with disabilities will promote inclusion and decrease stigma (De Witte et al., 2018; Asongu et al., 2019).

In relation to potential barriers, Byrd and Leon (2017) focused on three main aspects that prevent the inclusion and approach of students with disabilities in the use of so-called specialized Assistive Technologies: 1- AT is not available or accessible to students with disabilities. 2- High costs and precarious financing represent a limitation for the placement of AT for students with disabilities. 3- Lack of training in the use of virtual devices and platforms is the most prevalent barrier to the development of students with disabilities.

Copley & Ziviani (2004) identified limitations to their use in the field of education for people with disabilities. These include lack of suitable training and support for teachers, negative attitudes, insufficient assessment and planning processes, inadequate funding, difficulties in managing equipment and time-related barriers. Along these lines, there are many studies that have highlighted the lack of teachers' training in the application of Assistive Technology programs (Murray & Rabiner, 2014; Howard-Bostic et al., 2015).

Purpose and research questions

AT aims to help people with disabilities overcome their limitations (Sauer et al., 2010). Due to the rapid development of technology, there is a need to update research results on the impact of AT for the inclusion of students with disabilities. Therefore, the purpose of this research is aimed in two directions: on the one hand, to assess the overall state of AT research to improve the inclusion of students with disabilities. On the other hand, to investigate the themes and future lines of research in this field.

The specific research questions addressed are:

Q1. What are the trends in scientific production on assistive technology for students with disabilities in the field of education?

Q2. What are the findings on the use of Assistive Technology for students with disabilities between 2009 and 2020 in education?

Q3. What are the limitations on the application of Assistive Technology among students with disabilities in education?

Q4. What are the main lines of research in this field according to the keywords of the reviewed papers in the field of education?

Method

A systematic review of bibliographic analysis has been carried out using analytical screening techniques and document quantification (Fernández-Batanero, Reyes-Rebollo & Montenegro-Rueda, 2019) in accordance with the guidelines and standards for systematic reviews

of the PRISMA Statement (Preferred Reporting Items for Systematic reviews and Meta-Analyses) (Liberati et al., 2009), as an effort to locate all relevant scientific studies that aim to assess the impact of AT on improving the inclusion of students with disabilities. Likewise, social network analysis techniques have been used (Knoke & Yang, 2008) using visual representation with the VOSviewer software. This methodology enables the quantification of scientific output related to inclusion and assistive technology.

Data sources and search strategy

To carry out this review of the literature, four databases have been used to find eligible studies on Assistive Technology for students with disabilities. The databases included were Web of Science, Scopus, ERIC and PsycINFO. Consequently, the main reasons for choosing these four databases were their scientific impact and internationally recognized prestige in the academic community of the social sciences and education fields.

To obtain the articles, we applied an advanced search model using the following descriptors in the title, summary or key words fields: assistive technology (AT), inclusion and disability. To give greater accuracy to the study, Boolean operators "AND" and "OR" were incorporated into the different searches. We also tracked reference lists from relevant papers. Searches for studies were limited from 2009 to 2020, in order to extract the most current research in this field. The bibliographic search was carried out in March 2021, and obtained 741 results. After the elimination of duplicate studies, 321 articles remained for eligibility screening.

Eligibility criteria

Firstly, the PICO strategy (Population, Intervention, Comparison, and Outcome) was used to define the eligibility criteria. In this regard, we followed the recommendations of Pertegal-Vega, Oliva-Delgado and Rodríguez-Meirinhos (2019): population, phenomenon of interest, context, and study design.

The procedure for the selection of publications, in order to obtain in-depth evaluation about the validity of all included studies, was carried out through a double screening using the inclusion-exclusion criteria. Articles were restricted to peer-reviewed journal articles in

Table 1 Inclusion and exclusion criteria

Criteria	Inclusion	Exclusion
Publicacion date	2009–2020	Prior to 2009 and after 2020
Publicacion type	Original research academic articles in peer-reviewed journals.	Book chapters, review article, reports, thesis, dissertations, or proceedings
Focus of article	Articles focused on assistive technology in the field of special education	Articles did not include assistive technology in the field of special education.
Research method	Quantitative, qualitative and mixed methods were included (empirical study)	Reviews of other articles

the last decade. The following inclusion and exclusion criteria were used to identify study articles (Table 1):

Process flow of the systemactic review

Using these inclusion and exclusion criteria, we filter the publications following the recommendations for systematic reviews and meta-analyses. Figure 1 shows the PRISMA flow diagram followed for search, identification, screening, eligibility and inclusion processes (Moher et al. 2009). To increase reliability, all authors of the manuscript participated in the selection of the studies to include.

A first initial search, based on a combination of the different selected descriptors, identified 188 articles in the four selected databases. It was also completed with a manual search by reviewing the reference lists of the identified articles, selecting 28 articles. In total, 216 articles have been selected.

After a first reading of titles and abstracts, duplicate articles were removed, resulting in the elimination of 86 items. Subsequently, an exhaustive verification of the remaining 130 articles was carried out, assessing the established selection criteria, and 99 items were deleted for the following reasons: type of document (52) or inadequate context (47). Finally, 31 articles were obtained (Fig. 1).

Coding procedures and data analysis

To analyse the 31 selected studies, a data extraction table was developed to facilitate the review, which included (a) identification of authors and year of publication, (b) participants' information, (c) methodological design of the study, (d) results and AT included in the study, (e) number of citations of article, and (f) country, resulting in a database that has subsequently been presented descriptively (Appendix 1).

Fig. 1 Sample selection flowchart
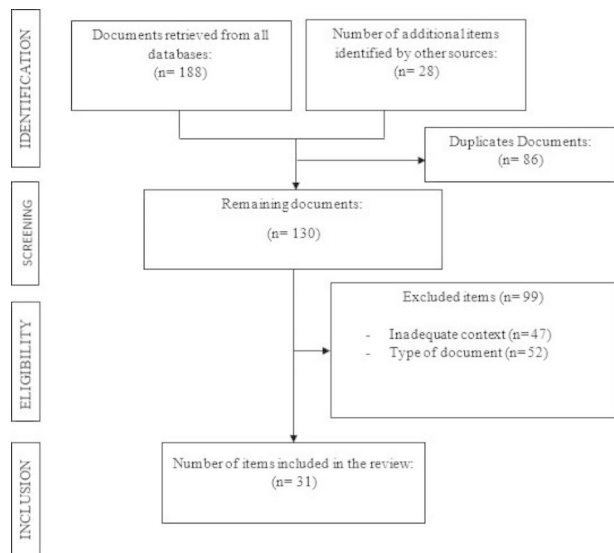
Results

This section reports the results, both quantitative and qualitative, obtained in this study. The data are shown in the following sections in response to each of the research questions stated above.

Overview of research on Assistive Technology for students with disabilities

This systematic literature review has drawn 31 articles from the different databases analysed. The review focused on scientific articles produced between 2009 and 2020, which aimed to evaluate the impact of the use of assistive technology in the education of students with disabilities. As see in Fig. 2 (below), where the distribution of the relevant studies published during this period is shown, there is an increasing trend in research in this field. Looking at the analysis of the year of publication of these studies, it is shown that the publication trend starts from the year 2017 to the present. Between the years 2009–2016 there was a small number of articles published. However, from 2017 onwards, an increase in the number of publications on this topic can be observed.

Figure 3 displays the number of studies provided by each country. Looking at the location of the countries where these studies analysed were carried out, we can show that they were mainly carried out in the USA (n = 16), followed, although less substantially, by Brazil
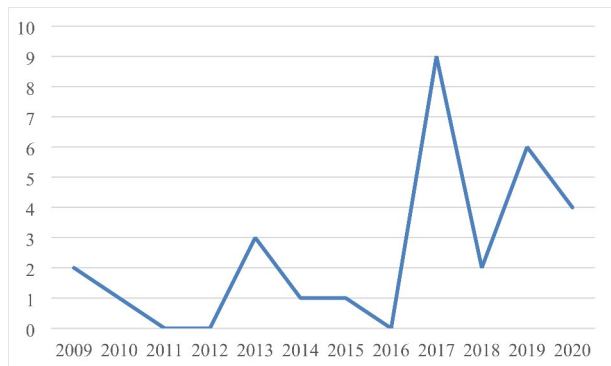
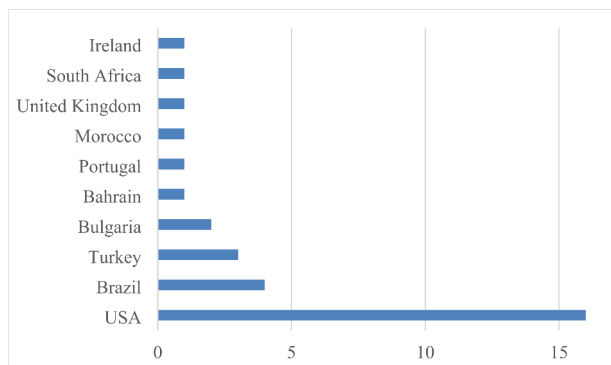**Fig. 2** Distribution of articles by year

Fig. 3 Distribution of the articles analysed by country

(n=4) and Turkey (n=3). The figure shows that research attracts interest in countries all over the world.

The analysis of the study design used does not provide an overview of how research in this field is being approached. These data indicate that, in terms of study design, 58.06% of the studies are conducted qualitatively. Quantitative studies are less common (38.71%), while only one study reviewed is classified as mixed (3.23%) (Fig. 4).

Research into the use of assistive technology applied to any stage of education has been undertaken. Thus, the data show that the educational level with the highest application of assistive technology is secondary education (41.94%), followed by primary education (38.71%). Studies aimed at the university stage are lower (12.90%). In the case of Early Childhood Education, there are very few (6.45%).

Citation analysis is one of the types of research that determine the impact of publications in scientific processes (Cañedo Andalia, 1999). In this way, the quality and impact of the research in this field is not yet relevant, because most of the publicationshave received between 0 and 5 citations (70.97%), 19.35% between 5 and 10 citations and only 9.38% have received more than 10 citations.

Benefits of using Assistive Technology for students with disabilities

Among the type of Assistive Technology used for this group of students, we find a wide variety of tools. Among them, the use of Web 2.0 stands out (28.57%), such as the use of
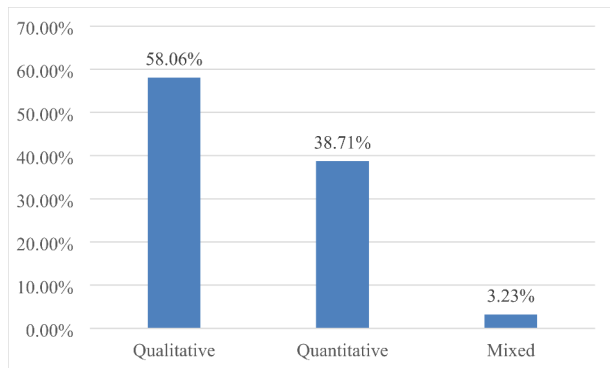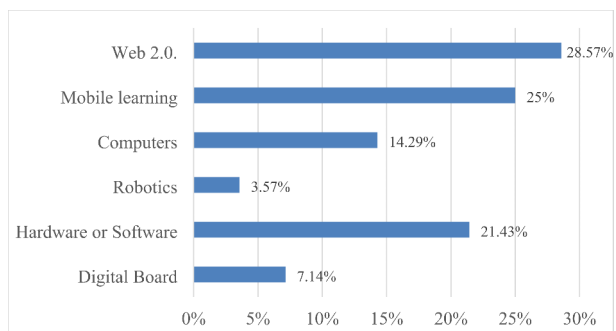
Fig. 4 Type of methodology used

Fig. 5 Main Assistive Technology for student inclusion

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social networks, websites, browsers…; mobile learning (25%), among which we find the Tablet, the iPad or the mobile phone; or the use of hardware or software (21.43%) (Fig. 5).

Considering the articles reviewed, these tools are being used mainly with visually impaired students (25%), followed by hearing impaired students (21.43%) and physically impaired students (14.29%). Students with autism (10.71%), intellectual disability (7.14%) or behavioural disorder (3.57%) are less likely to be used. The rest of the publications (17.86%) do not specify the type of disability (Fig. 6).

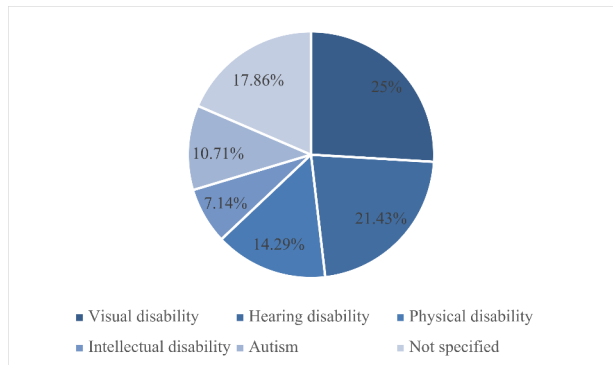**Fig. 6** Students using assistive technology

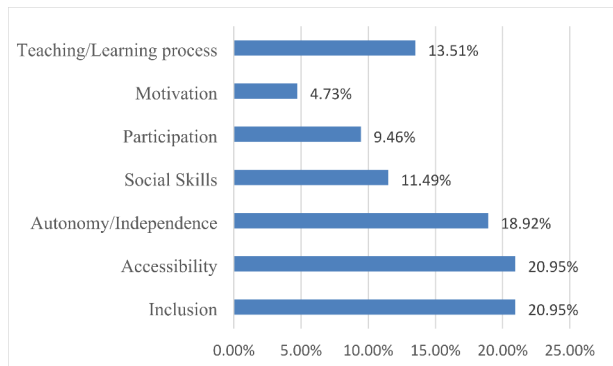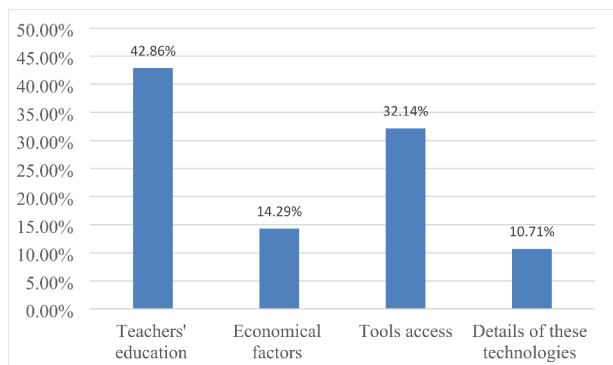**Fig. 7** Benefits of the use of Assistive Technology

Fig. 8 Difficulties in the use of Assistive Technology

AT provides students with a set of benefits such as inclusion (20.95%) and accessibility (20.95%) to school, as stated by the articles selected in this review. Among other benefits, we find that they improve the teaching-learning process (13.51%), the development of autonomy and independence (18.92%), the acquisition of social skills (11.49%), the participation (9.46%) and the motivation (4.73%) of students (Fig. 7).

Limitations of the use of Assistive Technology with students with disabilities

All the articles reviewed point out the importance of the use of Assistive Technology as a required tool for students with disabilities at school. However, there are still different challenges that schools must overcome in order to apply these tools with their students. Among the main difficulties found, there are mainly the need for teacher training and education (42.86%), as well as the difficulties of access to them (32.14%) (Fig. 8).

Lines of research on the use of Assistive Technology with students with disabilities

In order to analyse the research topics addressed in the literature in this field, an analysis of the relationships between the automatically extracted keywords or Key Words Plus (KW+) from the 31 studies analysed was carried out using the VOSviewer programme. Using the process of analysing the network map, three main themes were identified through analysis in the data. These were: "AT as an enabler of inclusion and participation" (cluster 1), "barriers to effective use of AT" (cluster 2) and "possibilities and benefits of AT" (cluster 3).
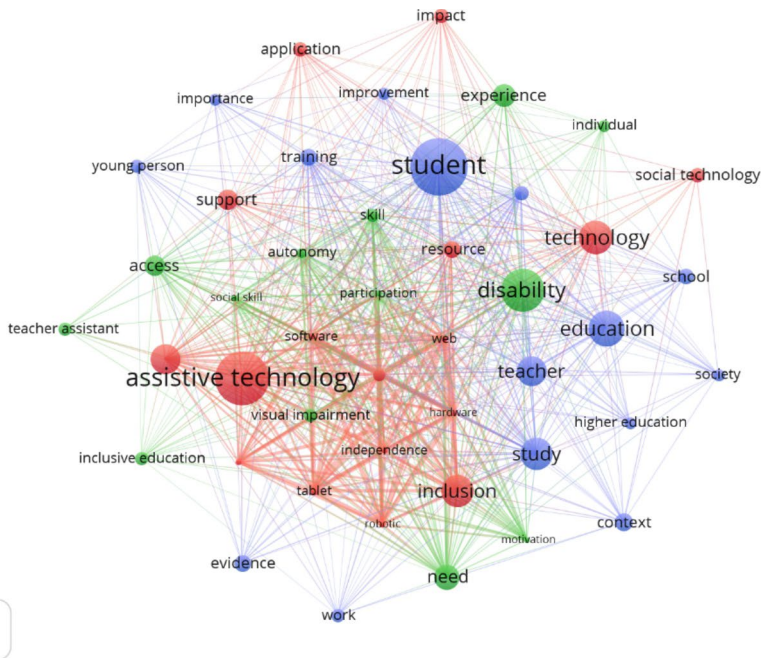

Fig. 9 Labelled bibliometric map

Therefore, a total of 45KW+has been extracted. In Fig. 9, the 3 groups or clusters can be clearly observed, which have been generated according to the similarity between them. The size of each node and their distance from each other sets the relationship between them.

The 3 thematic clusters that defined the main research topics in this field are:

Cluster1: identified in red, this is the main theme on which this study focuses, i.e. the impact of Assistive Technology on the inclusion and accessibility of students with disabilities. It can be noted that this cluster includes terms such as assistive technology, inclusion, technology, resource, impact, software, web, tablet, support, social technology, and robotic.

Cluster 2: it appears in blue, and it is related to the barriers or obstacles that hinder the application of Assistive Technology in education. In this group some of the most prominent elements are teacher training, education, higher education, society, school, context, training, and evidence.

Cluster 3: is shown in green. This group stands out for the benefits of applying these tools to students with educational needs. It also refers to the possibilities offered by Assistive Technology to make accessible education for all. It highlights items such as: autonomy, participation, social skill, access, assistant teacher, inclusive education, motivation, disability, and skill.

On the other hand, we include the bibliometric density map where it is shown the relevance of the analyzed keywords. Therefore, the following cores can be highlighted (Fig. 10):

In the middle zone of the map (yellow color) are placed, due to their importance and co-occurrence, those most relevant keywords in the scientific production about Assistive Technology for students with disabilities (student, disability, assistive technology, teacher).

Fig. 10 Bibliometric map tagged

In the peripheral zone of the map (colors that tend to green), evidence shows less interest and level of co-occurrence in the current scientific production (impact, inclusive education, social technology, experience, assistant teacher).

Discussion and conclusions

This review explores the impact of scientific production related to Assistive Technology on the inclusion of students with disabilities published between 2009 and 2020. According to our findings, these tools emerge as suitable instruments for both accessibility and inclusion of students, as well as for meeting their educational needs during their learning process (Clouder et al., 2019; Satsangi et al., 2019).

Thus, among the papers reviewed, several noteworthy findings will be discussed, in response to the research questions proposed in this study. First, considering the first question on trends in scientific production over time (RQ1), we can mention that there are possible trends and indications that suggest an increase in the use of AT in education in the last few years. Research in this field over the last decade is not very relevant; however, from 2017 to the present, a progressive increase has taken place. We can also highlight that the impact and repercussion of these studies is not very high, since most of the articles have a very low citation rate. The more frequently a paper is cited, the more often the scientific community recognises the influence or impact of the cited topic (Cañedo Andalia, 1999). The scarce existence of scientific literature and its low impact is one of the main problems that may hinder the implementation of these tools in the classroom, because this field is underdeveloped. Similarly, the limited existence of scientific literature on the use of AT for the care of students with disabilities makes it difficult to answer the research questions posed. Even so, the findings help us to lay the foundations for working to improve the education of these people, both by offering technological solutions and by working on training and awareness-raising in this regard (Molero-Aranda et al., 2021).

With respect to the countries that concentrate the greatest scientific production in this field, it should be said that AT is of world-wide attention, so that AT research has been developed in different countries, mainly in the United States, followed by Brazil and Turkey. This fact enables a reflection on future research in order to know if the country and its context affect the use of these technologies for the inclusion of students.

In relation to the research designs that prevail in the studies analyzed, it should be noted that these mainly show a qualitative approach, with observation and interviews prevailing as data instruments, followed by quantitative ones.

The second research question (RQ2), related to the results of using AT with students with disabilities, aims to synthesise the positive impacts in terms of the improvements or benefits they bring to students. AT has a significant impact on academic engagement. The use of these tools was found to improve the academic performance of students with disabilities (Fortes Alves & Pereira, 2017; Tamakloe & Agbenyega, 2017; Bouck et al., 2020; Sivakova, 2020). Some articles also reported the benefits of AT for the development of autonomy and participation (Harper et al., 2017; Mercado de Queiroz & Presumido Braccialli 2017; McNicholl et al., 2020). The results show an increase in the acquisition of social skills (Ari & Inan, 2010; Murry, 2018). Finally, it is worth mentioning that these tools promote motivation and increase students' attention (Paula, 2003; Arpacik et al., 2018; Bondarenko,

2018). The results analysed point out that there are different types of Assistive Technology used according to the functionality that they want to provide, highlighting mainly the use of Web 2.0. Although there are still digital gaps, most schools and teachers have access to the Internet which means that they can use this available and low-cost resource, and it can support both student inclusion and learning (Lyner-Cleophas, 2009; Kamali Arslantas et al., 2019; Ok & Rao, 2019). Mobile learning also stands out (25%), including the iPad or smartphone. These devices are very useful because they are small and portable, and they enable the installation of relevant applications for these students (Ismaili & Ibrahimi, 2017; Brinsmead, 2019), a fact that has resulted a trend in the use of these tools in recent years, agreeing with previous studies (Fichten et al., 2014). In this way, we can outline that the most generic resources are mainly used (McNicholl et al., 2020). The use of other useful resources to encourage the participation of this group of students using hardware or software should also be highlighted (21.43%) (Emcarnaçao et al., 2017).

These tools are mainly relevant for visually impaired students, followed by hearing impaired and physically handicapped students (Quinn et al., 2009; Ferreira et al., 2013; Ismaili & Ibrahimi, 2017). Thus, it can be stated that AT is successful and necessary to ensure the inclusion of this population in the classroom; however, although it has many benefits for all students, its use also involves challenges and barriers associated with the use of AT in the classroom. These barriers can hinder the effective use of AT.

In this regard, in response to the third research question (RQ3), all articles identified situations where AT cannot be used effectively. These include inadequate training in the use of ATs with learners with disabilities by teachers or difficulties in accessing these tools (Copley & Ziviani, 2004; Johnstone et al., 2009; Coleman et al., 2015; Alammary et al., 2017; Ismaili & Ibrahimi, 2017; Byrd & León, 2017). Teacher training in AT is related to improved student academic performance by being able to select the most appropriate tool to meet the needs of their students (Jones & Hinesmon-Matthews, 2014; Laloma, 2005; Malcolm & Roll, 2017; Yankova, 2019). Difficulties of access hinder the implementation of AT in education. These are mainly associated with economic factors, lack of adequate supports or lack of funding (McNicholl et al., 2019; Atanga et al., 2020).These tools may effectively support student inclusion by providing adaptations, but their high cost, because some resources such as the iPad are quite expensive, limits their access to wealthier consumers (Flanagan et al., 2013; Koch, 2017; Brinsmead, 2019). As a result, it is clear that rural areas have less resources and greater difficulties to access them than urban areas (Davis et al., 2013).

The main research topics in this field (RQ4) taking into account both the review of the articles and the analysis of the bibliometric maps helped to identify the different main topics involved within this field of research. Firstly, the importance of the use of AT as a facilitating element for school inclusion is highlighted, providing access for all students to education, including those with some kind of disability or educational need. Secondly, it highlights the benefits of implementing Assistive Technology with students with disabilities. Finally, it is related to the barriers or obstacles that hinder the application of Assistive Technology in the education of students with disabilities. As well as the possibilities offered by Assistive Technology to access education for the whole population.

Research and applications of the use of assistive technology with learners with disabilities have been conducted around the world. However, despite these efforts, it has

not been possible to integrate the appropriate tools to satisfy the main needs of these students. This review has identified important directions for future research and possible ways in which schools should consider integrating AT into the learning of students with disabilities. Teachers have a primary role in promoting the use of ATs, therefore, in order to achieve inclusion of students with disabilities, teacher need to acquire the necessary skills and competences (De Sousa, 2014; Roque, Perreira, Neto & Macario, 2018; Ahmed, 2020; Viana & Fontoura Teixeira, 2019; Arori, Al Attivah, Dababneh & Hamaidi, 2020). The results show that many of the generic devices (smartphones, digital board...) are used as AT, due to the fact that many offer accessibility features. Looking ahead, it is a need to integrate universal design into teacher technology training to maximise the benefits for all learners (Messinger-Willman & Marino, 2010).

Implications for further research

The limitations found have been addressed taking into account the results of this review because, although it has been possible to note how current research in this field is developing worldwide, it would be useful to identify the most appropriate AT to meet the needs of students according to their disabilities, as well as to promote training plans for teachers in order to implement these tools properly in the classroom.

In this way, researchers should explore the use of AT in relation to the type and degree of disability of learners. In this sense, it is also necessary to investigate effective teaching and learning strategies for these learners. In order to do so, it is necessary for teachers to have an adequate level of training, so that they can apply these tools in the classroom.

Limitations

A limitation of this paper is that the selection of the articles analyzed is restricted to the databases selected by the authors, although they are the most important for the educational scientific community. Therefore, in future research it would be desirable to study this topic with a wider and more extensive scope, including other articles from journals indexed in other databases with less scientific recognition, but which may include good practices.

N	Study	Students	Method	Results	Cites	Country
1	Johnstone et al., (2009)	Primary Education	Quantitative	Students with visual impairment receive adaptations to read with high and low technology.	7	USA
2	Quinn, B.S., Behrmann, M., Mastropieri, M., Chung, Y., Bausch, M.E., & Ault, M.J. (2009)	Primary Education	Quantitative	Schools mainly use ATs for students with multiple disabilities.	32	USA
3	Ari, I.A. & Inan, F.A. (2010)	University Education	Quantitative	Students use AT to support writing or to perform research.	15	Turkey

N	Study	Students	Method	Results	Cites	Country
4	Davis, T.N., Barnard-Brak, L. & Arredondo, P.L. (2013)	Primary Education	Qualitative	Students from rural districts have fewer assistive technology devices compared to urban ones.	6	USA
5	Ferreira, M.I., Travassos, X.L., Alves, L., Sampaio, R., & Pereira-Guizzo, C.D. (2013)	Primary Education	Qualitative	Findings include how children's communication improved with digital play, in order to plan more effective treatments using assistive technology.	5	Brazil
6	Flanagan, S., Bouck, C.E. & Richardson, J. (2013)	Secondary Education	Quantitative	Teachers reported that it was an effective literacy support. Barriers to its use are also reported: cost and lack of training/experience.	18	USA
7	De Sousa (2014)	Primary Education	Qualitative	The results include the importance and benefits of AT and distance education in student inclusion, as well as teacher training.	0	Brazil
8	Coleman, M.B., Cramer, E.S., Park, Y. & Bell, S.M. (2015)	Primary Education	Qualitative	Teachers need training to be able to apply AT properly.	7	USA
9	Alammary et al., (2017)	Primary Education	Quantitative	AT support the teaching and inclusion process of students with ID	1	Bahrain
10	Encarnação, P., et al. (2017)	Primary Education	Qualitative	The ATs developed enable children with physical disabilities to participate in academic activities and promote their participation in school.	6	Portugal
11	Fortes Alves, M.D., Pereira, G.V. & Viana, M.A.P. (2017)	Primary Education	Qualitative	Information technology is an important tool in the inclusion process and can promote the independency and autonomy of students with visual impairment.	0	Brazil
12	Harper, K.A., Kurtzworth-Keen, K. & Marable, M.A. (2017)	Primary Education	Qualitative	AT showed an increase in the independence, social relationships and learning development of students with disabilities.	1	USA
13	Ismaili, J. & Ibrahimi, E.H.O. (2017)	Secondary Education	Qualitative	Results show improvements in accessibility and inclusion of learners	8	Morocco
14	Koch (2017)	Secondary Education	Qualitative	Integrated technology promotes accessibility for students with physical disabilities	2	USA
15	Malcolm, M.P. & Roll, M.C. (2017)	University Education	Quantitative	AT may help to meet the needs of students with behavioural disorders.	1	USA

N	Study	Students	Method	Results	Cites	Country
16	Mercado De Queiroz, F.M. & Presumido Braccialli, L.M. (2017)	Secondary Education	Quantitative	The conclusion of the study was that these students with physical disabilities require assistive technology to develop their writing and computer skills, due to their limitations.	1	Brazil
17	Tamakloe, D. & Agbenyega, J.S. (2017)	Preschool Education	Qualitative	The use of AT may improve all children's learning and development.	1	USA
18	Ahmed, A. (2020).	Primary Education	Qualitative	The results show that teachers support the use of AT but they are not trained.	3	USA
19	Arpicik, O., Kursun, E. & Goktas, Y. (2018)	Secondary Education	Qualitative	Interactive whiteboard promotes learning among students with intellectual disabilities	0	Turkey
20	Murry (2018)	Secondary Education	Qualitative	The results show that e-books promote students' social skills.	0	USA
22	Kamali Arslantas, T., Yildirim, S. & Altunay Arslantekin, B. (2019)	Secondary Education	Mixed	Web-based AT improved the learning (vocabulary) of students with VI.	0	Turkey
23	Ok, M.W. & Rao, K. (2019)	Secondary Education	Qualitative	Browsers, and computers, may improve students' learning	0	USA
24	Lyner-Cleophas (2019)	Secondary Education	Qualitative	AT and Internet access can contribute to improve student inclusion	0	South Africa
25	Satsangi, R., Miller, B. & Savage, M.N. (2019)	Secondary Education	Qualitative	AT helps to achieve their goals, to promote independence and enjoyment.	2	USA
26	Yankova (2019)	Primary Education	Quantitative	The study shows that teachers are not well trained in the use of AT.	0	Bulgaria
27	Arori, Y.M., Al Attiyah, A., Dababneh, K., & Hamaidi, D.A. (2020)	Preschool Education	Quantitative	Teachers use AT according to the needs of their students.	0	USA
28	Atanga, C., Jones, B.A., Krueger, L.E. & Lu, S.L. (2020)	University Education	Quantitative	Teachers are interested in using AT, but they feel they are not well prepared. In addition, there are funding barriers.	2	USA
29	Bouck, E.C., Park, J. & Stenzel, K. (2020)	Secondary Education	Quantitative	The AT (virtual manipulator) assisted students to solve mathematical problems.	0	USA
30	McNicholl et al., (2020)	Secondary Education	Quantitative	The importance of AT for improving student participation and well-being is highlighted.	0	Ireland

N	Study	Students	Method	Results	Cites	Country
31	Sivakova (2020)	Secondary Education	Qualitative	The benefits of cloud-based ATs and the possibility of using them in inclusive education with students with physical and hearing disabilities are presented.	0	Bulgaria

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Research involving Human Participants and/or Animals Human particpants and/or animals do not participate in this study.

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