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Strategies for Using Assistive Technology to Overcome Students with Learning Disabilities and Barriers in Elementary School

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ABSTRACT

The present study identifies the implementation of assistive technology in students with learning disabilities and strategies for using assistive technology to overcome learning barriers. This research is a literature review (SLR) study conducted on articles from 2013 to 2024 using the Scopus database. The data obtained was saved in *R.I.S. format and integrated into the Reference Manager (Mendeley). Furthermore, VOS-viewer software was used to see the data making the resulting information more interesting and clear. PRISMA flowchart maps the data search process, the number of abstracts screened, and the text retrieved. A total of 8 articles were accessed for this study. The results showed that teachers must be well-prepared to improve their pedagogical skills by effectively using media and learning resources to achieve the desired goals. Technology or media must adapt teaching materials to the individual needs of students. The research results are expected to provide insight into the need for strategies to overcome learning barriers in students with learning disabilities.

Keywords*: *inclusive education, assistive technology, learning barrier, students with learning disability

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INTRODUCTION

In this modern era, the development of information technology is proliferating (Imene & Imhanzenobe, 2020)Technology is a man-made system used to improve capabilities, facilitate activities, and provide various facilities (Zabir, n.d.). Educational technology is needed in learning activities, so that students are more actively involved in the learning process and help students understand concepts more visually and interactively (Mokalu, Panjaitan, Boiliu, & Rantung, 2022; Suyuti et al., 2023). Technology is used to facilitate the development of learning activities by individuals and groups to create effective and efficient learning and a systematic and critical approach to solving educational problems. (Salsabila, Ilmi, Aisyah, Nurfadila, & Saputra, 2020).

One of the uses of technology in education is to make it easier for every student to find information and knowledge and broaden their horizons(Maritsa, Salsabila, Wafiq, Anindya, & Ma'shum, 2021). The importance of technology in the world of education includes supporting learning facilities to achieve the desired results and be more efficient in terms of time, cost, logistics, and other institutional issues (Manongga, 2022). Technology-based learning can tailor teaching materials and methods to the needs of each student so that each student can learn at their own pace (Persico, Manca, & Pozzi, 2014). Assistive technology refers to various technologies specifically designed to help people with disabilities and difficulties in daily activities. Assistive technology aims to improve the independence, accessibility, and quality of life of the people who use it. (Ravneberg & Söderström, 2017).

A person's characteristics affect the way they interact with technology. Characteristics refer to attributes or traits inherent in something or someone and are used to describe or identify them (Podsakoff, MacKenzie, & Podsakoff, 2016).Characteristics include physical, psychological, or social traits that distinguish one entity or individual from another (Hamsar, 2023). In the context of education, student

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characteristics are characteristics or traits possessed by students that affect their learning style, ability to interact and develop in the learning environment (Alannasir, 2020). Each student is unique; their characteristics can change with time and learning experiences (Suskie, 2018). Teachers need to know and understand student characteristics during the learning process to analyze the learning difficulties students face. At the primary school level, students often experience learning difficulties, especially in reading, writing, and arithmetic. This is because students need these essential competencies before entering primary education. (Grigorenko et al., 2020; Susanti, 2018).

One type of learning difficulty is slow learning, a child whose intellectual potential is limited, so the learning process becomes slow. Children who are slow learners have their characteristics and face various learning problems at school (Nurfadhillah, Septiarini, Mitami, & Pratiwi, 2022). Based on previous research, various types of assistive technology have been successfully integrated into learning environments to improve access and engagement of students with special needs (Rahmi Tanjung et al., 2024). Adaptive technology and assertive technology are technologies that play an essential role in supporting the learning process of students with special needs (Naufal, 2020). Using assistive technology that suits the needs of children with special needs can improve the quality of learning carried out by students (Lutfio, Kapitang, Wijaya, Azizah, & Husna, 2023). Based on previous research, of course, it is essential to carry out research related to assistive technology for children with special needs in elementary schools so that educators This research has never been carried out by previous researchers, so the results of this study are expected to help educators master strategies and methods in using assistive technology. This study discusses in more detail the implementation of assistive technology for students with learning disabilities in primary schools and efforts to improve assistive technology in primary schools. This study aims to analyze the implementation of assistive technologies in supporting students with learning disabilities in elementary schools. It seeks to identify strategies for overcoming learning barriers by utilizing assistive technologies tailored to the unique needs of students with disabilities. Furthermore, the study evaluates the role of teacher preparedness and pedagogical adaptation in the successful integration of these technologies in inclusive classrooms. It also explores the impact of assistive technology on improving accessibility, engagement, and academic performance for students with learning disabilities.

METHOD

This research uses a systematic literature review. Systematic Literature Review (SLR) is a technique of identifying, evaluating, and analyzing a variety of existing and relevant information in the literature or references to answer research questions through more profound analysis (Snyder, De Brey, & Dillow, 2019; Xiao & Watson, 2019). S.L.R. has been shown to help in summarizing the latest knowledge on a particular topic in a systematic and transparent method to answer research questions (Kurniati, Kelmaskouw, Deing, Bonin, & Haryanto, 2022).

In the systematic review process for the selection of research articles, we used the term "Technology and inclusive education" in the search menu in the Scopus database. The data obtained was saved in *RIS format and synchronized to Reference Manager (Mendeley). A PRISMA flowchart was used to map the data search process, the number of abstracts screened, and the text retrieved. Furthermore, VOS-viewer software was used to visualize the data, resulting in a more communicative, attractive, and clear presentation of the information. Scopus searches were conducted using TITLE-ABS-KEY (technology, AND inclusive AND education, AND children) AND PUBYEAR > 2012 AND PUBYEAR < 2025 AND (LIMIT-TO-KEY) AND (LIMIT-TO-KEY). 2025 AND (LIMIT-TO (DOCTYPE, "ar")) AND (LIMIT-TO (SRCTYPE, "j")) AND (LIMIT-TO (LANGUAGE, "English")) AND (LIMIT-TO (OA, "all") AND (LIMIT-TO (SUBJAREA, "PSYC") OR LIMIT-TO (SUBJAREA, "ARTS") OR LIMIT-TO (SUBJAREA , "MULT") OR LIMIT-TO (SUBJAREA , "MATH")). Articles that met the inclusion criteria were thoroughly reviewed for data analysis purposes and then categorized to extract systematic information according to the criteria established for this

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study. The analysis was conducted with a focus on assistive technology for students with learning disabilities in primary schools, specifically on (1) technology, (2) inclusive education, and (3) children.

The systematic literature review (SLR) employed in this study was designed to identify, evaluate, and analyze relevant information from existing literature to answer the research questions. The inclusion and exclusion criteria were established to ensure a focused and systematic approach. The following describes the criteria and categories on the table 1.

Table 1. The Criteria of Research

No	Components	Aspect	Describe
1.	Inclusion Criteria	Time Frame	Articles published between 2013 and 2024 were included to provide a contemporary overview of the topic
		Keywords	Searches were conducted using the keywords “technology,” “inclusive education,” and “children”.
		Document Type	Only peer-reviewed journal articles (DOCTYPE: "ar") were considered, excluding conference papers, book chapters, reviews, and other non-article formats.
		Language	Only articles published in English were included to ensure consistency and accessibility for analysis.
		Access Type	Open-access articles were prioritized to facilitate unrestricted review of the full texts.
		Subject Area	Articles were selected from disciplines such as psychology, arts, multidisciplinary studies, and mathematics to cover diverse perspectives.
2.	Categorization	Focus Areas	Assistive technology, inclusive education, and children.
		Research Methods	Quantitative, qualitative, and mixed-method studies.
		Relevance	Alignment with the study objectives, particularly strategies for using assistive technologies in elementary schools.

This structured and transparent methodology ensures a comprehensive synthesis of the latest knowledge on assistive technology in inclusive education, focusing on its application for students with learning disabilities in elementary schools.

RESULTS AND DISCUSSION

RESULT

This section consists of several sub-sections that present the research results in detail. The first step is to explain the document analysis results, and then present the findings visually to clarify the information. Eight articles were selected for inclusion in this study after four stages of selecting articles that met the criteria.

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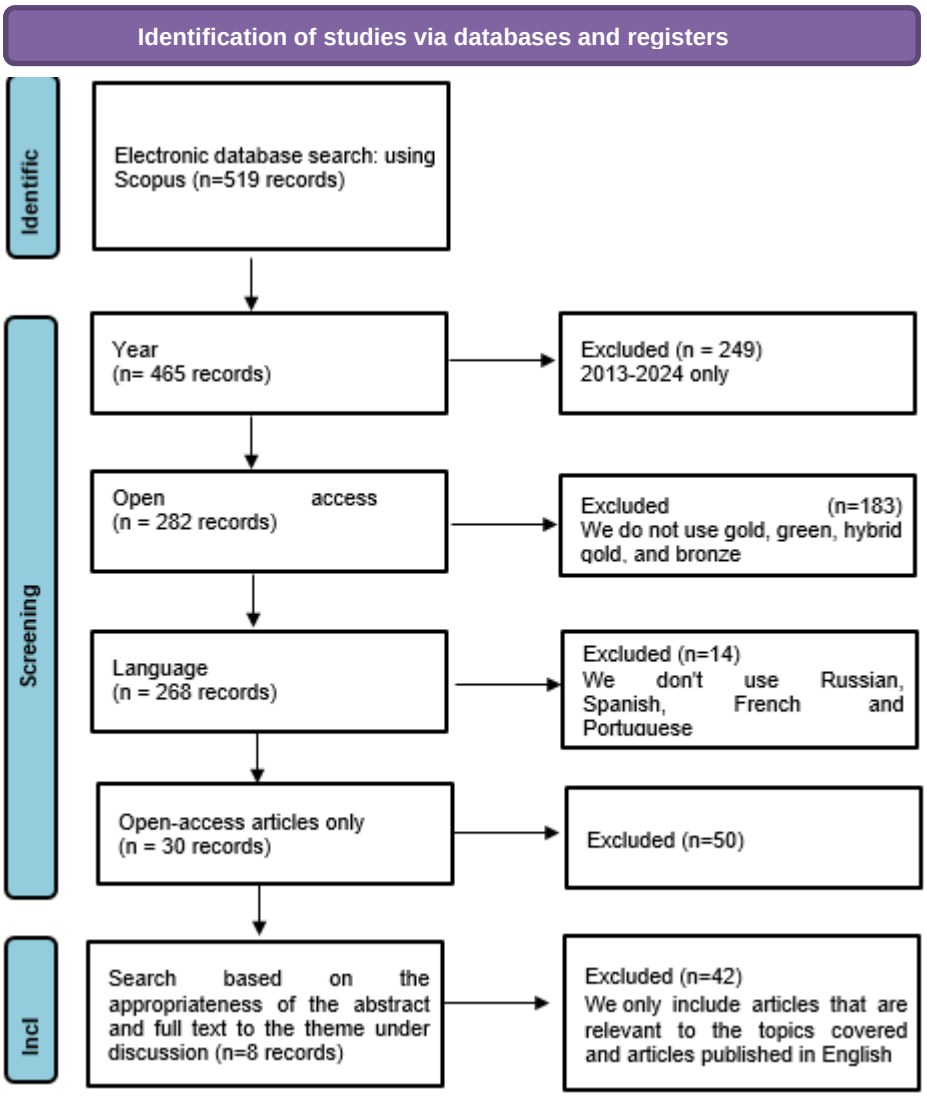

Figure 1. P.R.I.S.M.A. flowchart for systematic literature review detailing the database search, number of abstracts screened, and text retrieved. For more information, visit: http://www.prisma-statement.org/

Furthermore, articles that met the criteria are analyzed by mapping the title, author, objectives and research results. The following description is contained in Table 1.

Table 1. Summary of leading articles, sorted by author name

No.	Title	Author	Destination	Result
1.	The use of technology and teachers' competency development in inclusive	(Diana, Sunardi, Gunarhadi, & Yusuf, 2020)	Providing insights related to inclusive education in preschool education institutions and teachers' skills in	Teachers need to improve their classroom management skills, using media and educational resources

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No.	Title	Author	Destination	Result
	education learning: A study in cenral Jawa, Indonesia		utilizing learning technology in inclusive classrooms.	to enable effective learning.
2.	Humanistic Foundation of Inclusive Pedagogy	(Gazizovich, 2015)	Examine the prerequisites and concepts of inclusive education development	The idea of inclusive education involves creating an atmosphere of humanistic relationships between participants in the educational process.
3.	Formation of professional readiness in teachers for inclusive education of children with health limitations	(Karynbaeva, Shapovalova, Shklyar, Borisova, & Emelyanova, 2017)	Present a report on teachers' professional preparation for inclusive education	Teachers have started to apply the learned techniques in dealing with children with health limitations
4.	Readiness for work under inclusive education conditions as stage of formation of teacher's inclusive culture	(Ketrish, Fedorov, Tretyakova, Andruhina, & Shehetz, 2019)	Examine the primary stages of establishing and developing inclusive education systems in Russia and abroad.	Inclusive education has very different values, if these values are not clearly defined or understood, then the inclusive education system can easily be destroyed
5.	Designing instruction and learning for cognitively gifted pupils in preschool and primary school	(Mooij, 2013)	Designing optimal teaching and learning conditions for gifted students from the beginning of the preschool period	Using a set of guidelines to design different educational support and learning enhancement for different students
6.	Study of Distance Learning Opportunities in Inclusive Education System	(Nigmatov, 2015)	Promote distance learning technologies that can address key issues of children with disabilities	Distance learning allows for intercommunication between children during disciplinary and thematic collection activities.
7.	Innovative technologies	(Razumova, Ruslyakova,	Provides information related to innovative	nnovative technologies make it

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No.	Title	Author	Destination	Result
	of psychological support for children with disabilities	Bazhenova, Shpakovskaya, & Tokar, 2019)	methods of psychological assistance in the context of supporting children with special needs using canis therapy and puppet theater psychotechnology.	possible to create a safe psychotherapeutic environment, reduce resistance, anxiety, and remove psychological safeguards used by children and adolescents with special needs.
8.	Establishing the governmental policy to promote engagement within the inclusive education system in Indonesia	(Warman, 2021)	Researching teachers views on inclusive education	Teaher competencies are average, with higher preparation indicating better pedagogical skills.

Research Articles Identified by Search Term

Figure 1 shows the results of an initial search through Scopus, concentrating on "article, abstract, keywords" which found 519 articles. From these, we identified 465 articles from 2013-2024, and we also only included articles that had open access. From these criteria, we obtained 282 articles that met the criteria, indicating that 183 articles did not fall into the gold, green, hybrid gold, and bronze categories. Furthermore, we identified 268 articles that were in English, while the remaining 14 articles were excluded because they were written in Russian, Spanish, French and Portuguese. In addition, we also used the article document type only, resulting in 80 articles. 188 articles were excluded because they were conference articles, book chapters, conference reviews, book reviews, and notes. From this final stage, we obtained 8 research articles. The distribution of the 8 articles published in the last 10 years (2013-2021) in Scopus is illustrated in Figure 2.

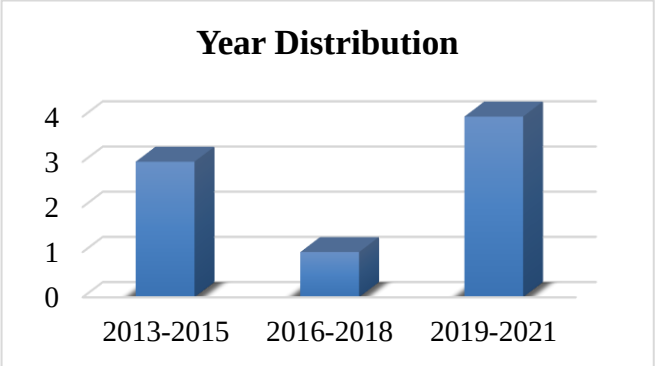

Figure 2. Distribution of 8 articles over the last 10 years (2013-2021) in Scopus

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Based on Figure 2, the number of articles published on the topic of strategies for using assistive technology for students with learning disabilities in elementary school is in 2013 with 1 article, 2015 with 2 articles, 2017 with 1 article, 2019 with 2 articles, 2020 with 1article, and 2021 with 1 article. In years that are not mentioned above, including 2014, 2016, and 2018, there are no articles that match the topic raised, so the distribution chart is made with a range of three years.

Research trends relating to strategies for using assistive technology for students with disabilities are depicted in Table 1. Most studies adopted a qualitative approach, with 6 articles or 75% of the total. In addition, there was quantitative research with one article (12%), and mixed methods research was also found (13%). These findings indicate that investigating strategies for using assistive technology can be done through a combination of qualitative, quantitative and mixed approaches.

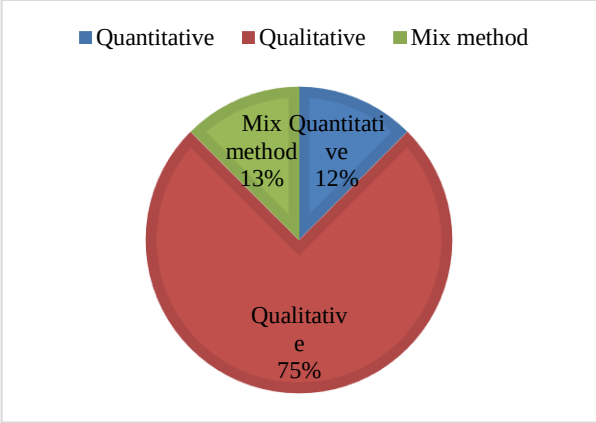

Figure 3. Distribution of research methods adopted in the study

Table 2. Type of research on strategies for using supporting technologies

No	Type of Research	Total	Reference
1.	Quantitative	1	(Ketrish et al., 2019)
2.	Qualitative	6	(Diana et al., 2020; Gazizovich, 2015; Karynbaeva et al., 2017; Mooij, 2013; Nigmatov, 2015; Razumova et al., 2019)
3.	Mix Method	1	(Warman, 2021)

Furthermore, the article was analyzed through the VOSviewer application. VOSviewer is used to analyze and visualize bibliometric data, such as relationships between authors, institutions, or keywords in scientific literature. This application makes it easier for researchers to map research trends, explore relationships between articles, and visually identify clusters or subfields of research. In addition, VOSviewer helps present complex data in the form of intuitive interactive maps, enabling in-depth analysis of scientific literature efficiently. The following Figure 4 shows the results of analyzing the relationships between articles throgh keywords.

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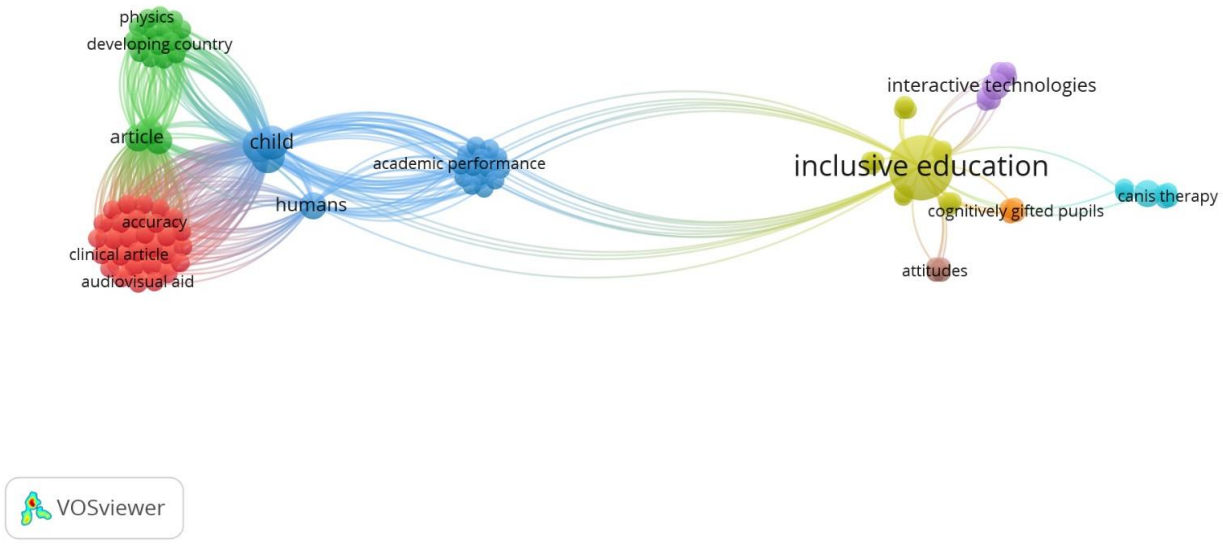

Figure 4. VOS-Viewer for co-occurrence aalysis+keywords

DISCUSSION

Inclusive education integrates students with special needs in the learning environment by providing opportunities to learn alongside peers without being limited by physical condition or intelligence. Children in inclusive education may have challenges in the learning process such as developmental disabilities, autism or physical disabilities (Imaniah & Fitria, 2018). Interactive technologies can provide tools such as software or hardware that facilitate physical accessibility. Inclusive education with interactive technology is essentially about creating an inclusive learning environment for all individuals, where the uniqueness of each child is valued and empowered through the use of technology to support the learning process (Garg & Sharma, 2020). Based on the visualization of bibliometric data displayed through the VOSviewer application, the map shows the relationship between keywords related to the topic of "inclusive education". In this analysis, several groups of keywords (terms) were formed, which are marked with different colors, representing thematic clusters that appear in research related to inclusive education.

The main keyword in this cluster is "inclusive education", which is at the center of the analysis. This term is connected to several other keywords such as cognitively gifted pupils and interactive technologies, showing that research on inclusive education also addresses how interactive technologies can be used to help students with special talents or higher cognition. The blue cluster shows the close relationship between children and academic performance. This means that research related to children often links their academic performance in the context of inclusive education. This research may focus on how inclusion strategies can improve children's academic performance, especially in formal education settings. The red cluster involves terms such as clinical article, audiology and accuracy, which suggests that inclusive education research also intersects with clinical studies, especially in the context of assessing the accuracy of audiology aids. This may suggest a link between special needs, such as hearing loss, and the role of inclusive education in supporting students with specific medical needs. There is a link between developing countries and physics, which may indicate that research on inclusive education in developing countries also involves aspects of science learning, particularly physics. This indicates the problems faced in developing countries with implementing inclusive education in science subjects. The purple and yellow clusters involve the topic of interactive technology associated with therapy, which suggests that technology in inclusive education is not only used to support academic learning, but also to assist therapy in educational settings, perhaps for students with special needs or disabilities.

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Overall, this data visualization provides a comprehensive overview of key themes in inclusive education research, with a focus on the role of technology, clinical interventions and student academic performance. Current research trends tend to explore how technology can be utilized in inclusive education, especially in developing countries, as well as the importance of a multidisciplinary approach that includes both clinical and pedagogical aspects to support holistic inclusive learning (Hernández-Torrano, Somerton, & Helmer, 2022) This study analyzed existing research publications between 2013-2024 addressing assistive technology for students with learning disabilities in primary schools. With the exception of 2014, 2016 and 2018, there was no research related to the topic. Based on the selected articles, teachers play an important role in managing the learning process in both regular and inclusive classes. In the learning process, teachers must also have preparation so that pedagogical skills are better by utilizing media and learning resources so that goals are achieved (Puspitarini & Hanif, 2019). Inclusive education requires teachers to clearly understand the nature of the inclusive approach as well as knowing the age and psychological characteristics of students (Haug, 2017). The implementation of assistive technology for students with learning disabilities must be accompanied by adequate teacher training and effective and efficient technical support (Erdem, 2017). In addition, parental involvement in understanding and supporting the use of these technologies is also important in order to achieve optimal outcomes for students with learning disabilities in primary schools (Olmstead, 2013).

Students with learning disabilities are faced with various problems in every learning process. Technology is one of the crucial factors for the successful implementation of education, including inclusive education (Ahmad, 2015). The use of technology in inclusive schools provides challenges for teachers who must use more learning strategies and methods to be able to understand their students and make them feel comfortable and have the same rights as other normal children (Mayangsari, Salsabila, Tari, Zulaikha, & Dewi, 2020). So in inclusive education, it must be supported by the use of technology that is adequate for the student's disability. Table 1 summarizes the key information, including the objectives, levels, methods, and main results of the study. The main results are briefly outlined in the last column. The results show the need for assistive technology for students with learning disabilities.

The use of assistive technology in basic education has become an important strategy to overcome learning barriers in students with disabilities. Technologies, such as visual aids, interactive applications and adapted learning software, enable better access to learning materials and assist students in processing information in ways that suit their needs. For example, students with visual disabilities can use screen reader devices or digital braille to access text, while students with hearing impairments can utilize assistive listening devices or written text as an adjunct to instruction (Hallahan, Kauffman, & Pullen, 2013).

Another effective strategy is the use of technology-based apps that are tailored to students' abilities. These apps include programs that can be set up to adjust difficulty levels, provide instant feedback, and motivate students through gamification. Such technology is particularly beneficial for students with learning disabilities, such as dyslexia, ADHD, or sensory processing disorder, as it can provide a more individualized approach to learning (Bouck, 2016). The application of technology also aids in multisensory teaching, which allows students to utilize multiple senses to learn, for example through audio, visual and physical interaction. This is particularly important for students with disabilities as it gives them multiple ways to process and understand information, and supports their diverse learning styles (Gordon, Meyer, & Rose, 2016).

In addition, collaboration between teachers, parents and technology specialists is essential in ensuring that assistive technology is used optimally. Teachers should be trained in the use of these tools and personalized education plans (I.E.P.s) should include appropriate technology to support students' learning needs (Rodríguez & Cumming, 2017). Assistive technology provides opportunities for students with disabilities to learn more effectively and participate in inclusive educational environments. Efforts made to improve assistive technology for students with learning disabilities in primary schools can be made with the following strategic steps, 1) Individual needs assessment of the needs and abilities of students with learning disabilities (Woolfolk, 2016), 2) Development and implementation of adaptive learning software to provide

customized learning experiences (Xie, Chu, Hwang, & Wang, 2019), 3) Ensure that all technology used is accessible to students with special needs (technology accessibility), 4) Provide training for teachers and education staff on how to use assistive technology (Sholeh & Efendi, 2023), 5) Collaboration with parents in the learning process using assistive technology (Jeong & Hmelo-Silver, 2016), 6) Monitoring and evaluation to keep track of the use of assistive technology and its impact on students with learning disabilities (Adebisi, Liman, & Longpoe, 2015), 7) Innovation and research to improve the learning ability of students with learning disabilities (Izzo & Bauer, 2015). In SLR research, there are limitations in that, in specific years, no research articles match the topic, so the number of articles identified is limited.

CONCLUSIONS AND RECOMMENDATION

Implementing assistive technology for students with learning disabilities challenges teachers in preparing for learning. Assistive technology for students with learning disabilities in primary schools can positively impact the learning process. Technology adapts teaching materials to the individual needs of students. Assistive technology can help create a more inclusive and effective learning environment and provide opportunities to reach the full potential of students with learning disabilities. Teachers must prepare themselves well to improve their pedagogical skills by effectively utilizing media and learning resources to achieve the desired goals. Efforts to strengthen technology include evaluating individual needs, developing and implementing software, ensuring technology is accessible to students with special needs, monitoring technology use, and innovation. Teachers also need to develop strategies for using assistive technology to overcome learning barriers faced by students with disabilities in primary schools, to improve learning effectiveness, and to provide better support. Teachers' thorough preparation will significantly impact the learning process and influence the quality of teaching and student learning outcomes. The objectives of this research are to explore the implementation of assistive technologies in overcoming learning barriers for students with disabilities, analyze teacher strategies in inclusive education, and evaluate the collaborative role of educators, parents, and technology specialists. Additionally, it aims to assess the impact of these technologies on accessibility, engagement, and learning outcomes, while proposing strategies for their effective integration.

Based on the findings, it is recommended to provide comprehensive teacher training, ensure accessibility to affordable assistive technologies, and foster collaboration among educators, parents, and specialists. Governments should support this integration through policies and funding, while continuous monitoring and feedback guide improvements. Lastly, raising awareness and advocating for inclusive education can ensure equal opportunities and better learning outcomes for all students.

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