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The Low- to High-Tech Assistive Technology for the Learning Process of Students with Special Needs in Inclusive Classrooms : A Literature Review

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Abstract: This study aims to systematically review the use of assistive technology in the learning process of students with special needs in inclusive classroom settings. Assistive technology covered in this research ranges from low-tech tools (such as picture communication boards) to high-tech devices (such as adaptive learning applications and computer-assisted communication systems). Using a literature review method, this study analyzes scholarly publications from 2015 to 2025, focusing on the effectiveness, challenges, and implementation strategies of assistive technology in inclusive education. The findings indicate that assistive technology plays a crucial role in enhancing accessibility, participation, and learning outcomes for students with special needs. However, its success is highly influenced by teacher preparedness, appropriate technology selection, and institutional support. This study offers insights and recommendations for educators and policymakers to optimize the use of assistive technology in fostering inclusive and adaptive learning environments.
Keywords: assistive technology, students with special needs, inclusive education, low-tech, high-tech, literature review

Teknologi Berteknologi Rendah hingga Tinggi untuk Proses Pembelajaran Siswa Berkebutuhan Khusus di Kelas Inklusif: Tinjauan Pustaka

***Abstrak**: Perkembangan ilmu pengetahuan dan teknologi yang semakin pesat ikut berperan juga dalam proses pembelajaran peserta didik disabilitas. Peserta didik disabilitas membutuhkan teknologi asistif yang mendukung proses pembelajarannya maupun kegiatan sehari-harinya. Penelitian ini mengkaji penggunaan teknologi asistif dalam proses pembelajaran peserta didik disabilitas di lingkungan kelas inklusif. Teknologi asistif yang dimaksud mulai dari yang berteknologi sederhana, menengah, hingga berteknologi tinggi. Melalui metode literature review, studi ini menganalisis berbagai publikasi ilmiah yang diterbitkan antara tahun 2015 hingga 2025, dengan fokus pada efektivitas, tantangan, dan strategi implementasi teknologi bantu dalam pendidikan inklusif. Setelah dikaji secara mendalam diperoleh hasil bahwa teknologi asistif berperan penting dalam meningkatkan aksesibilitas, partisipasi, dan hasil belajar peserta didik disabilitas. Namun, keberhasilannya sangat dipengaruhi oleh kesiapan guru, pemilihan teknologi yang sesuai, serta dukungan institusi pendidikan. Penelitian ini memberikan wawasan dan rekomendasi bagi pendidik dan pengambil kebijakan untuk mengoptimalkan pengimplementasian teknologi asistif dalam mewujudkan pembelajaran yang inklusif dan adaptif.*
***Kata kunci**: teknologi asistif, peserta didik disabilitas, pendidikan inklusif, low-tech, high-tech, literatur review.*

1. Introduction

Education is a right for every human being. Education must be of high quality and meaningful, including for students with disabilities. The services provided to students with disabilities are in accordance with the Regulation of the Minister of National Education (Permendiknas) No. 70 of 2009, which is an education delivery system that provides opportunities for all students who have abnormalities and have the potential for intelligence and/or special talents to attend education or learning in one educational environment together with students in general (Rosita et al., 2020). Inclusive education is also interpreted as (1) an innovative and strategic approach to expanding access to education for all children with special needs, including children with disabilities, (2) as a form of educational reform that emphasises anti-discrimination, the struggle for equal rights and opportunities, justice and expanding access to education for all, and (3) a process of responding to the diverse needs of all children through increasing participation in

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learning, culture and society, and reducing exclusivity in and from education (Yuwono et al., 2021).

To support effective and meaningful learning in inclusive classrooms, assistive technology (AT) is essential. Assistive technology is a technological device or system designed to help individuals with disabilities communicate, move around or access information (WHO, 2022). Assistive technology includes a variety of tools and devices, ranging from low-tech, such as visual images and manual communication boards, to high-tech, such as artificial intelligence-based software, adaptive learning applications, and computer-assisted communication aids.

The development of technology in education has opened up great opportunities for learners with disabilities to be more actively involved in teaching and learning activities in inclusive classrooms. Some literature shows that the use of assistive technology can improve the independence, engagement, communication and academic achievement of learners with disabilities, especially in inclusive classroom settings. Assistive technology enables learners with disabilities to overcome barriers caused by the loss or malfunction of physical organs, thereby achieving higher levels of self-confidence, being able to live independently, and actively participate in daily activities (Zen et al., 2025). Meanwhile, according to (Putri et al., 2023) the impact of assistive technology on learners with disabilities can be very large and broad, namely: improving learners' academic achievement, so that this can increase their confidence in learning, motivation, and involvement in learning activities. Assistive technology can minimise the stigma of learning difficulties as it creates equality for all learners. Assistive technology can also help learners with disabilities become more independent in learning and everyday life. Assistive technology can help learners with disabilities collaborate with teachers, parents and peers.

In recent years, assistive tools for reading and writing have become increasingly available on tablets and smartphones, offering greater accessibility than traditional computers. Applications like text-to-speech (TTS) and speech-to-text (STT) are especially effective in supporting students with decoding and writing difficulties (Svensson et al., 2021). Smartwatches like the Apple Watch and Samsung Gear function as cross-disability assistive technologies, offering features such as activity tracking, reminders, and stress management that support students with various disabilities, including visual, hearing, physical, emotional, and autism-related challenges (Putri et al., 2025). Assistive technologies support children with motor disabilities in engaging with their peers by enhancing mobility and independence. These include walking aids such as crutches and walkers, grab bars and handrails, manual and powered wheelchairs, motorized scooters or adapted toy vehicles, and specially modified vehicles for independent driving (Erdem, 2017).

However, there are not many literature reviews that comprehensively compare and examine different types of assistive technology from the low-tech to high-tech spectrum in relation to the learning process in inclusive classrooms. In fact, a full understanding of the spectrum of assistive technology and its context of use can provide a basis for educators, policy makers and education service providers to choose and implement the most appropriate strategies. In addition, the use of assistive technology still faces various challenges, both in terms of accessibility, teacher readiness, selection of technology that suits the individual needs of students, and the effectiveness of its implementation in diverse classroom contexts.

Therefore, this study aims to review and analyse the existing literature on the use of assistive technology in the low to high spectrum, and evaluate the effectiveness and challenges faced in its implementation in inclusive classrooms. The results of this review are expected to contribute to the development of more inclusive, adaptive and technology-based inclusive education practices.

2. Materials and Methods

This research is a literature review study with a descriptive qualitative approach. Literature review study is an activity of summarising articles in journals or proceedings, books, and other documents relevant to the chosen topic (Prawitasari et al., 2023). The purpose of this study is to collect, analyse and synthesise various results of previous studies related to the use of assistive technology (from low-tech to high-tech) in supporting the learning process of students with special needs in inclusive classrooms.

The data sources in this study were obtained from scientific journal articles, academic books, and reports of relevant international organisations, such as UNESCO and WHO. These sources were obtained through systematic searches on various online databases such as: Google Scholar, Scopus, and ResearchGate. The criteria for the selected articles included:

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published between 2015-2025, focus on the use of assistive technology in the learning of learners with disabilities, studies conducted in the context of inclusive education, articles in English or Indonesian, and 17 manuscripts were selected.

Researchers used search keywords such as 'assistive technology in inclusive classrooms', 'low-tech and high-tech AT for special needs students', 'inclusive education and technology support', and the like. The selection process was conducted in three stages: 1. Identification: Initial search using keywords. 2. Screening: Eliminating irrelevant articles based on the title and abstract. 3. Eligibility: Full reading of articles that met the criteria to determine their eligibility for analysis.

Data were analysed using a thematic synthesis approach, which grouped the findings from the various studies into key themes such as: classification of assistive technology based on complexity (low, mid, high-tech), benefits of assistive technology in the learning process, implementation challenges in inclusive classrooms, and the role of teachers and institutional support.

3. Result and Discussion

The studies obtained in this literature review were 18 articles. The data focused on objectives, variables, and outcomes. Table 1 lists the characteristics of the studies obtained. Table 2 shows a summary of assistive technology implementation based on its complexity (low, mid, high-tech) on the learning process of learners with disabilities. All studies were published in the last ten years (2015 to 2025).

Table 1. Characteristics of the studies obtained

No	Title	Author	Year
1	The Use of Interactive Digital Content as Assistive Technology for Student with ADHD	Nuril Kusumawardhani Soeprapto Putri, Marisa Karsen, Hanny Juwitasary, Pingkan C. B. Rumondor, Desi Maya Kristin Kurang baik	2023
2	Assistive Technology for Children with Learning Disabilities: A Systematic Literature Review	Ahmad Haiqal Abd Khalid, Nur Nazihah Mohkhlas, Noor Azura Zakaria, Mazidah Mat Rejab, Ruwinah Abdul Karim, Suharsiwi	2023
3	Assistive Technology in Improving Daily Living Activities of Children with Intellectual Disabilities	Nika Rizki Nur Prawitasari, Asri Wijiastuti, Budiyanto	2023
4	Pemanfaatan Teknologi Asistif dalam Proses Pembelajaran Siswa dengan Hambatan Penglihatan	Zykra Zakiah, Veroyunita Umar, Muhammad Nurrohman Jauhari, Muchamad Irvan	2024
5	Penggunaan Teknologi Asistif: Peningkatan Kemandirian Penyandang Disabilitas Fisik	Lya Fayola Zen, Hadiyanto Abdul Rachim, Nurliana Cipta Apsari	2025
6	Pemanfaatan Teknologi Asistif dalam Pendidikan Inklusif	Bayu Widyaswara Suwahyo, Punaji Setyosari, Henry Praherdiono	2022
7	Students with Special Educational Needs and Assistive Technologies: A Literature Review	Raziye Erdem	2017
8	Assistive Technology for Autism Spectrum Disorder: Systematic Literature Review	Nur Anis Suhaila, Norazah Mohd Nordin	2022
9	Use of Assistive Technology in Inclusive Education: Making Room for Diverse Learning Needs	Fouzia Khursheed Ahmad	2015

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10	High-Tech or Low-Tech? Impact of Assistive Technology in School Settings for Students with Visual Impairments: Review of Research	Sevgi Kirboyun	2020
11	Using Assistive Technology in Teaching Children with Learning Disabilities in the 21st Century	Rufus Olanrewaju Adebisi, Nalado Abubakar Liman, Patricia Kwalzoom Longpoe	2015
12	A Survey Of Teachers' Awareness And Use Of Assistive Technology In Teaching Children With Special Needs In North Central Nigeria	Abani Gwanshak Shikden	2015
13	Digital Applications as Assistive Technology for Students with Disabilities	Ajani Restianty, Suwandi Sumartias, Purwanti Hadisiwi, Hanny Hafiar	2024
14	Assistive Technology Classification for Students With Disabilities in Higher Education: A Systematic Literature Review	Nuril Kusumawardani Soeprapto Putri, Umi Laili Yuhana, Daniel Oranova Siahaan, Wenny Rahayu, Eric Pardede	2025
15	Teknologi Asistif Sebagai Media Pembelajaran Bahasa Indonesia Siswa Berkebutuhan Khusus	Muhammad Afnani Alifian, Azizatuz Zahro, Didin Widyartono	2023
16	Kondisi Pemenuhan Teknologi Asistif Bagi Anak Berkesulitan Belajar Spesifik (ABBS) di Sekolah	Angga Damayanto, Ishartiwi, Rendy Roos Handoyo, Ernisa Purwandari	2021
17	Knowledge, Skills and Professional Development of Special Education Teachers to handle Assistive Technology for Students with Disabilities	A.Blossom Cygnet, S.Silamboli, S.Kanmani, J.Sujathamalini, K. Gunasekaran	2019
18	Teknologi Asistif untuk Anak-anak dengan Disabilitas di Sekolah Inklusif dan Sekolah Luar Biasa di Indonesia	Anna Hata, Han Wang, Joko Yuwono, Shinsaku Nomura	2023

Assistive technology is equipment, software programmes or product systems used to assist individuals with disabilities in improving, maintaining or developing their functional skills (Khalid et al., 2023). According to (Hata et al., 2023) assistive technology needs to be understood as a means to support the learning and independence of children with different types of disabilities and needs, and not just focusing on the materials or tools. A learner-centred approach, which considers the unique and individual characteristics of children with disabilities, is essential. This is because assistive technology is part of the solution. The needs of the learner should be prioritised, and not the other way round. Various types of assistive technology can be utilised by teachers to support the learning process of learners with disabilities, ranging from low, medium and high-tech assistive technology, so teachers need skills in selecting and using the right assistive technology according to the needs of learners with disabilities in the learning process.

Low-tech assistive technology refers to any type of assistive device that does not utilise electronics in its function (Zen et al., 2025). Low-tech assistive technology devices have several benefits, including accessibility for all, ease of replacing components if the device is damaged, and do not require specialised maintenance or training (Suwahyo et al., 2022). According to (Suwahyo et al., 2022), medium-tech assistive technology is a device that generally does not require special training when used and is affordable, usually requires low electrical power (using batteries) but is not too complicated. High-tech assistive technology, on the other hand,

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refers to the use of electronic devices or computers as solutions to assist people with disabilities. The use of these high-tech systems often requires ongoing training and support for users to operate the devices effectively (Zen et al., 2025).

Table 2. Implementation of assistive technology to the learning process of learners with disabilities

No.	Learners with disabilities	Assistive Technology	Technology Level	Technology Function Assistive Technology
1.	Visual disability	braille textbook	Low	Reading learning
		braille labels	Low	Reading learning, environmental orientation
		Audio Book	Medium	Reading learning, maths, life skills, social
		Tactile book	Low	Life skills learning
		Talking calculator	Medium	Maths learning
		Voice recorder	Medium	Enables all aspects of learning
		Braille printer	High	Enables all aspects of learning
		NVDA, JAWS	High	Enables all aspects of learning
		Eye glasses	Medium	Enables all aspects of learning
		B-Touch Braille Mobile Phone	High	Communication
		Stick	Low	Orientation and mobility
2.	Hearing Impairment	Hearing aid/cochlear implant	High	Enables all aspects of learning
		Text to speech	High	Enables all aspects of learning
		Speech to tech	High	Enables all aspects of learning
		Signaling device	Low-Medium	Communication, Security
		Closed captioning in video	High	Enables all aspects of learning
		Communication board	Low	Communication
		Eye gaze board	Low	Communication
		PowerPoint presentations	High	Enables all aspects of learning
3.	Intellectual Disability	Audio book	Medium	Reading, maths, life skills, social learning

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		Number line app	High	Numeracy learning
		Number line board	Low	Numeracy learning
		Animated videos	High	Enables all aspects of learning
		Kinect V2 software	High	Pembelajaran keterampilan hidup
		Augmented reality	High	Enables all aspects of learning
		Graphic Organizer (GO)	High	Pembelajaran bahasa
		wordwall	High	Enables all aspects of learning
		Word prediction software	High	Writing learning
		Tableware	Low	Life skills learning
		Traditional games, blocks, puzzles, balls	Low	Social and leisure learning
4.	Physical disability	Pencil grip	Low	writing
		Manual-electric wheelchair	Medium - High	mobility
		Crutches	Low	mobility
		Push button	Medium	Life skills learning
		Larger keyboard	Medium	writing
5.	Mental disability	Mobile appliation	High	Enables all aspects of learning
		Speech-generating device	High	communication
		PECs	Low	communication
		video	High	Enables all aspects of learning
		Script training	Low	Social interaction learning
		Smart watch	High	Focus improvement

According to (Zakiah et al., 2024) in using assistive technology, there are several factors that teachers need to consider in choosing the right technology, namely technology must match the needs of students, the ease of students in using, the availability of support in using assistive technology, and considering an affordable budget so that students can access the assistive technology. Thus, special education teachers need to be equipped with how to select and implement appropriate assistive technology according to the needs of learners with disabilities in the learning process. Teachers should identify learners' needs, and ask learners' opinions on the assistive technology they will use to suit their interests. In addition, the role of the family in the implementation of assistive technology in learning is also very important, therefore it is hoped that there will be collaboration between the school and the family to implement assistive technology in the learning of learners with disabilities.

In addition to the above considerations, (Zen et al., 2025), outlines the challenges in implementing assistive technology, namely:

a. Expensive Price

Technological advances have created a variety of assistive devices that can provide a better quality of life for people with disabilities.

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However, many families who require assistive devices have difficulty in obtaining them due to financial constraints. In addition, institutions such as schools are also affected by budget constraints, making it difficult to obtain the necessary educational technology and training.

b. Stigma and Discrimination

Stigma refers to the negative perceptions or stereotypes that society may have of individuals with disabilities. This can result in embarrassment and discomfort felt by people with disabilities when using assistive devices. Whereas discrimination refers to the unfair treatment or rejection of individuals with disabilities. This can take many forms, such as unequal access to education or employment services, unequal treatment in social interactions, or unequal access to assistive technology itself.

c. Lack of Training on Assistive Technology

The lack of trainers, or teachers who are knowledgeable about these tools is one of the main factors that hinder the introduction and use of assistive technology. Without proper training, even though the devices have been provided, it is possible that the technology may not be optimally utilised. Therefore, educational institutions and professional trainers should work together with teachers and the government to provide training on how to use assistive technology.

d. Lack of Adequate Resources

Lack of resources in assistive technology implementation refers to the limitations that often arise when trying to implement assistive technology to help people with disabilities. Without access to adequate resources and support, this knowledge will be difficult to utilise. The use of assistive devices, especially in remote areas, is difficult because many of these areas do not have sufficient access to electricity and internet connections. The solution is to involve the government in providing electricity and connectivity in rural areas.

4. Conclusion and Suggestion

Based on the results of the literature review, it can be concluded that assistive technology plays an important role in various aspects of learning for students with disabilities. Assistive technology that can be used also varies, ranging from low, medium, to high-tech assistive technology. Each assistive technology has certain characteristics and functions whose selection must be adjusted to the needs and abilities of each learner. There are several most effective of assistive technologies used by students with visual impairments, include Braille textbooks, voice recorders, and screen readers such as NVDA and JAWS. A variety of assistive technologies including hearing aids, visual stimulation devices, and smartphones are widely used to support individuals with hearing impairments.

Various digital and interactive tools such as prompting videos, video tutorials, animated videos, augmented reality, and computer-based interventions have been employed to support learning and skill acquisition for individuals with intellectual disabilities. Students with physical or mobility impairments may rely on wheelchairs for navigating the school environment and use assistive input devices such as oversized keyboards or customized hardware to effectively interact with computers and other digital tools in the classroom. Mobile applications, which are software programs developed for portable devices like smartphones, tablets, and iPads, have become valuable tools in the education of individuals with intellectual disabilities because their flexibility, accessibility, and cost-effectiveness.

The implementation of assistive technology is influenced by several considerations and challenges, including the teacher's knowledge of various assistive technologies, their functions, and how to implement them; the cost of assistive technology that is less affordable for families, as well as schools; community stigma and discrimination against learners with disabilities; and uneven and inadequate resources. Therefore, teachers are expected to be more creative in seeing opportunities and maximising existing resources, as well as continuing to innovate in implementing learning for students with disabilities. It is also hoped that there will be increased cooperation from various parties, including schools, families, communities, social institutions, and the government to support better quality learning for students with disabilities.

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