

Impact of Assistive Technology on Learning among Students with Physical Disabilities: Evidence from Special Education Institutions in District Bhakkar, Punjab

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Abstract

Assistive technology (AT) has become a crucial educational support for enhancing learning for students with disabilities in special education institutions. Many special education institutions still have limited availability and effective use of assistive technology despite the recognized benefits. The aim of this study was to explore the impact of assistive technology on the learning of students with disabilities in special education schools. The research design is mixed-methods. Quantitative data were collected using structured questionnaires administered to heads of schools and special education teachers, and qualitative data were collected through semi-structured interviews with students with disabilities. The study was done in special education schools of district Bhakkar, Punjab, Pakistan, with purposive sampling. Descriptive and inferential statistics were used to analyze quantitative data using SPSS. Qualitative data was thematically analyzed. The results indicated that assistive technology significantly improved students' learning by increasing classroom participation, access to instructional materials, communication during learning activities, task completion, and academic performance. However, major barriers to effective implementation were identified as inadequate teacher training, limited availability of assistive devices, financial constraints and lack of technical support. The study concludes that improving availability of appropriate assistive technologies, strengthening teacher training and improving institutional support is critical to enhancing learning outcomes and promoting inclusive education for students with disabilities.

Keywords: Special Education, Students with Disabilities, Academic Performance, Assistive Technology, Learning.

Introduction

Assistive technology (AT) is an important component of special education through which children with disabilities are provided access to learning and effective participation in learning processes. Assistive technology is a wide range of devices, equipment, software and services that

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are used to improve the functional ability of a person with a disability. Assistive technology in educational contexts helps lower barriers to learning by making learning materials available and enhancing communication and task completion among students. Assistive technology has thus become an essential component of equitable and inclusive education for individuals with impairments. (Bryant & Bryant, 2012; Cook & Polgar, 2015; Ali & Faiz, 2022). Physical disabilities create barriers for students, which prevent them from engaging in classroom instruction and hinder their learning experiences. Barriers such as problems associated with mobility, handwriting, manipulating learning materials, and communication within the classroom environment tend to restrict the students' access to the curriculum as well as their involvement in educational activities. This is likely to lead to poor academic performance and restricted participation without adequate education support interventions. The use of assistive technology is provided to overcome these barriers through customized devices that help the students engage with the learning materials, communicate effectively, and participate in classroom instruction. It has been shown in previous researches that using assistive technology appropriately increases the students' academic performance, reading comprehension, classroom participation, and engagement in learning (Aftab et al., 2024; Alkahtani, 2023; Hanifah et al., 2025; Nazir et al., 2024). The role of assistive technology in the teaching-learning process has been stressed more strongly through inclusive education programs across the world. Today's assistive technologies can include low-tech devices such as writing aids, wheelchairs, walkers and communication boards, as well as hi-tech solutions such as speech-to-text programs, augmentative and alternative communication aids, adaptive keyboards and computer-based accessibility programs. They help students access academic materials, perform class tasks, and engage in collaborative learning environments. The literature shows that assistive technology plays a significant role in facilitating educational participation and curriculum accessibility and better learning outcomes when there is adequate training of teachers involved and support from institutions (Fernández-Batanero et al., 2022; Ali et al., 2024; Aftab, Irfan, & Amjad, 2024). Although there is a wealth of evidence of the positive impact of assistive technology on learning processes, but the implementation of this technology is still a problem in many developing countries such as Pakistan. In the existing literature, one can find several major obstacles that impede the implementation of assistive technology in the learning process, namely lack of funding, lack of assistive technology devices, lack of teacher training, lack of technical assistance, and poor implementation of inclusive education policies (Hameed & Manzoor, 2019; Ali & Faiz, 2022; Kazmi et al., 2023; Kamran & Bano, 2024; Sahito et al., 2024).

There is research on the effectiveness of assistive technology in education, but less research on its use, availability, accessibility and implementation. Moreover, there is no information about the effect of assistive technology on the academic performance of special education students in Pakistan. There is also less data regarding the use of assistive technologies in District Bhakkar where little research on assistive technology has been done. Moreover, there has been little research in the past that has considered the views of school principals, teachers, and students together to have an overall view of the impact of assistive technology on learning and barriers to its successful implementation. Hence, the present study was designed to investigate the effect of assistive technology on learning of disabled children studying in special education schools in District Bhakkar, Punjab, Pakistan. More specifically, the study examined the types of assistive technology used in the schools, its role in students' learning and classroom engagement, and the

challenges to effectively using it. The results of the study provide empirical information that can help improve the use of assistive technology for the benefit of disabled children.

Research Questions

1. What are the types of assistive technologies that are presently being employed in special education environment?
2. How is the application of assistive technology influencing students with disabilities' learning outcomes?
3. What is the contribution of teacher training towards the success of assistive technology integration?

Conceptual Framework

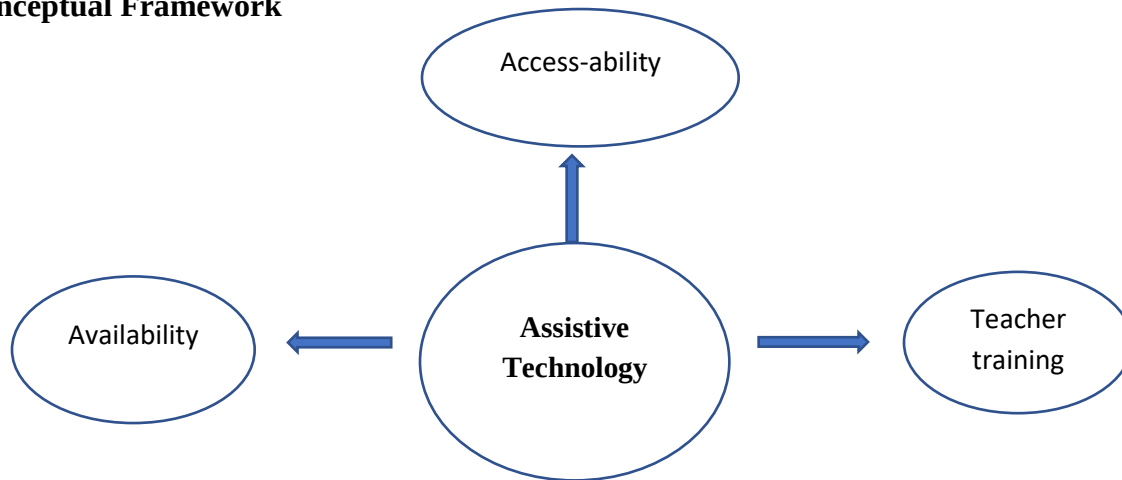


Figure 1. Conceptual Framework

Students Learning Outcomes

- Academic Performance
- Classroom Participation

Types of Assistive Technology

Assistive technology includes a range of devices, equipments, softwares and other services that facilitate the participation of learners with special needs in education programs. Depending upon the complexities and functionalities of these, they can be categorized as low, mid and high technology gadgets. The low-tech gadgets include inexpensive equipments like pencil grips, adapted desks, slant boards, walkers, wheelchairs, communication boards and many others which help learners with disabilities gain better physical access to learning. On the other hand, mid-tech assistive technologies include electronic organizers, portable magnifiers, audio recorders and adapted keyboards, while high-tech devices include speech-to-text software, screen readers, eye gaze systems, augmentative and alternative communication (AAC) gadgets and many others (Bryant & Bryant, 2012; Cook & Polgar, 2015; Dell et al., 2017).

Table 1. Types of Assistive Technology

Technology Level Description		Typical Example
Low-tech	Simple non-electronic or minimally technical supports that improve access, mobility, positioning, or communication.	Pencil grip, adapted desks, slant boards, walkers, wheelchairs, communication board.
Mid-tech	Electronic devices that provide moderate levels of support for organization, access, communication, or sensory needs.	Electronic organizers, portable magnifiers, audio recorders, adapted keyboards.
High-tech	Advanced digital or computerized systems that provide specialized access, communication, reading, or writing support.	Speech-to-text software, screen readers, eye gaze system, AAC devices.

Selection of Assistive Technologies

Choice of assistive technologies should be based on the needs, functional abilities, and goals of students, not simply on the availability of technology. Proper assessment and proper matching of students with the right devices will enhance their educational experiences. Many studies have proved that careful choice of technologies and integration of the devices in classroom instructions make learners participate well, increase curriculum accessibility and aid learners accomplish learning tasks (Alnahdi, 2014; Coleman, 2011; Zabala, 2005).

Role of Assistive Technology in Special Education

Assistive technology plays a significant role in special education because it helps to eliminate barriers to learning and provides students with disabilities access to educational opportunities. It helps learners access learning materials, take part in classwork, communicate effectively, and perform tasks that could not be performed due to physical challenges. With growing popularity of inclusive education, use of assistive technology has become critical in helping meet different learning needs and enable learners with disabilities participate in classwork (Ali & Faiz, 2022; Fernández-Batanero et al., 2022; UNICEF, 2022).

Apart from facilitating learning opportunities, use of assistive technology also assists teachers in implementing inclusive instructional practices. Appropriate implementation of assistive technology allows meeting different learning needs, engaging students, and making classrooms more accessible to everyone. In order for such technology to be successfully implemented in classrooms, several conditions should be met, including adequate teacher training, institutional support, technical assistance, and maintenance of assistive devices. All these factors have been consistently found important in previous research in relation to assistive technology implementation in special education (Alkahtani, 2013; Hameed & Manzoor, 2019; Kamran & Bano, 2024; Sahito et al., 2024).

Impact of Assistive Technology on Learning

Assistive technology in education has transformed the learning experience of students with disabilities by making information more accessible and promoting participation in classroom activities. Research has shown that assistive technology contributes positively to academic success, engagement in the learning process, access to curricula, effective communication, and comple-

tion of tasks by overcoming functional barriers that hinder learning. Students with appropriate assistive technology display higher levels of self-confidence, increased participation in instruction, and enhanced academic performance compared to those without assistive technology (Aftab et al., 2024; Alkahtani, 2023; Hanifah et al., 2025; Nazir et al., 2024).

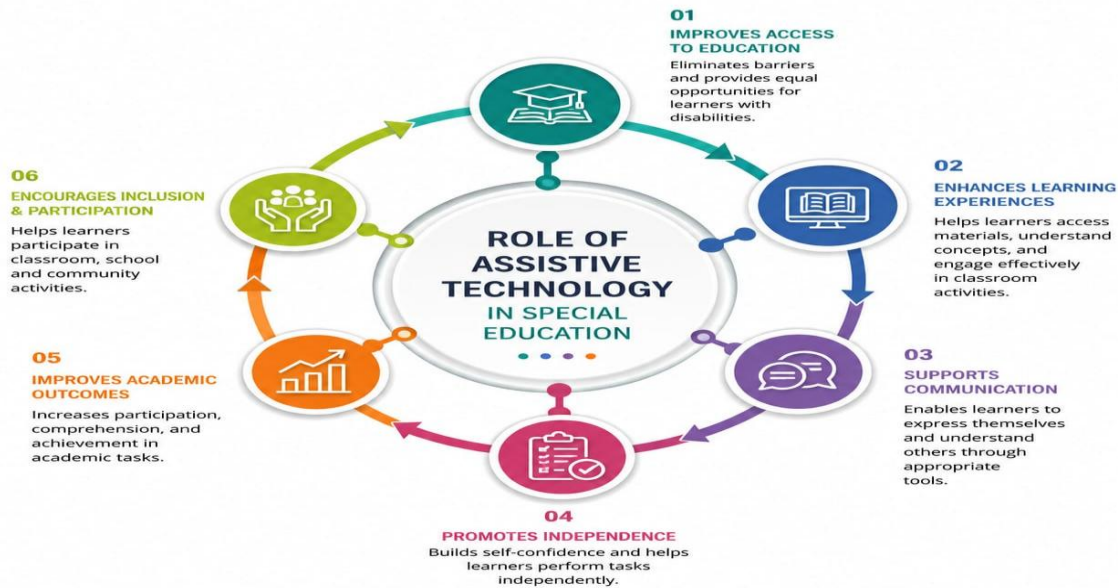


Figure 2. Role of assistive technology in special education

Numerous research studies have also found that assistive technology encourages the involvement in teaching and learning through access to learning materials and independent performance of academic tasks. Systematic literature reviews reveal that the educational effectiveness of assistive technology can be attained if appropriate technologies, teachers' training, and favorable learning environment are available in schools (Fernández-Batanero et al., 2022; Aftab, Irfan, & Amjad, 2024; Ali et al., 2024). However, lack of appropriate assistive devices, inadequate teacher training, lack of funds, and ineffective policy implementation prevent successful integration of assistive technology in many educational settings (Hameed & Manzoor, 2019; Kazmi et al., 2023; Kamran & Bano, 2024).

Challenges of Implementing Assistive Technologies

The use of assistive technology in the context of special education will require proper resource allocation, staffing, policy formation, and technical support. Nevertheless, numerous educational organizations still face numerous barriers that make the integration of such technologies within the classroom environment impossible. Budgetary issues become one of the major problems for institutions preventing the purchase, maintenance, and updates of assistive technology. That is why many organizations are still using primitive assistive equipment while modern technologies remain out of reach for most students (Kazmi et al., 2023; UNESCO, 2020).

Teacher Competence is one more important issue that determines the appropriate application of ATs. According to research, inadequate professional development for pre-service and in-service

teachers causes teachers' inability to choose, operate, and incorporate assistive technologies into the educational process. Furthermore, poor technical support, lack of collaboration between teachers, therapists, and administration of the school reduces the efficiency of using assistive technologies in the classroom environment (Sahito et al., 2024; Fernández-Batanero et al., 2022).

The success of employing assistive technologies is also significantly influenced by institutional and policy concerns. The lack of adequate policy implementation, poor monitoring mechanisms, and unequal distribution of educational resources cause discrepancies in access to assistive technologies. In order to overcome these problems, it is necessary to work on improving the policy implementation, increasing the number of trainings for teachers, technical support and investment in assistive technologies (Lindsay, 2011; Kamran & Bano, 2024).

Theoretical Framework

The current research is based on the Universal Design for Learning (UDL) framework which was developed by the Center for Applied Special Technology (CAST). The framework embodies the educational theory which suggests developing adaptable learning setting to accommodate the needs of all students, including those with disabilities. It consists of three fundamental principles of providing multiple means of engagement, representation, and action and expression to ensure equal access to learning for all students (CAST, 2018).

The concept of assistive technology plays an important role within the UDL framework as the main tool which is used to assist students with disabilities cope with various difficulties related to learning process. Using proper technological tools helps students access to instructional materials, communicate with their teachers, perform academic work and actively participate in class activities. Several studies have revealed that the use of assistive technology within inclusive educational settings helps increase curriculum accessibility, students' engagement and academic performance (Bryant & Bryant, 2012; Fernández-Batanero et al., 2022).

Therefore, the UDL framework is a proper theoretical base for the current study because it allows explaining the use of assistive technology in the provision of meaningful learning experience through overcoming barriers in educational and individualized instruction. Thus, this framework guided the investigation of the availability of assistive technology, its importance for the learning process of students, and the problems preventing its efficient use in special education schools.

Table 2. Theoretical Framework

Author	Theory	Relevance to Current Study
Michael Oliver (1983)	Social Model of Disability	Views disability as a result of barriers not just physical limitations. Assistive technology helps to remove these barriers making it easier for individuals with disabilities to take a part in learning.

Lev (1978)	Vygotsky	Constructivist Learning Theory	Emphasizes learning by doing and interacting with others. Assistive technology helps learners to understand by making the information accessible and them to join in.
CAST (Center for Applied Special Technology)		Universal Design for Learning (UDL)	Supports flexible learning environments. Assistive technology provide way for people to engage express themselves and access information, which improves learning and independence.

Materials & Methods

Research Design

Mixed methods research design was utilized to gather qualitative and quantitative data on the impact of assistive technology on the learning process of students with disabilities, providing a comprehensive understanding of the topic. Structured questionnaires were used for quantitative data collection, while semi-structured interviews were conducted with students for qualitative data.

Study Area

The study was conducted in special education institutions of District Bhakkar, Punjab, Pakistan. The chosen schools offer educational services to physically disabled students using different forms of assistive technologies.

Population and Sample

The population of the study included school heads, special education teachers and physically disabled students studying in government special education schools in District Bhakkar. Purposive sampling strategy was used in order to recruit participants having firsthand experience of the application of assistive technology. Thus, the sample included 4 school heads, 40 special education teachers and 79 students making the sample size equal to 123 participants.

Research Instruments

The data for the study were collected using two structured questionnaires and one semi-structured interview guide. Questionnaires were prepared independently for school heads and teachers to obtain information about the availability, use, and effects of assistive technology on students' learning processes. Students were interviewed through semi-structured interviews to gather information related to their experiences, learning benefits, and difficulties faced in using assistive technology.

Validity and Reliability

The validity of research instruments was assessed through content validity by experts in special education. Suggestions from experts were taken into account to make the instruments relevant

and appropriate. Pilot study was done prior to the actual data collection. Teacher questionnaire had very high internal consistency, with Cronbach's Alpha coefficient higher than 0.90.

Data Collection Procedure

Permission was sought from the concerned educational authorities and the participating schools before data collection. Personal interviews were conducted with school heads and teachers in form of questionnaires while interviews were conducted in person with students using the appropriate language.

Data Analysis

The quantitative data were examined with the Statistical Package for the Social Sciences (SPSS). The data was analyzed using descriptive statistics such as frequencies, percentages, mean, and standard deviation. Thematic analysis was used to evaluate qualitative data from interviews, which involved categorizing and thematicizing interviewee responses.

Ethical Considerations

Ethical considerations were kept in mind throughout the study. Participation was entirely voluntary, and ethical clearance was obtained from all the respondents as well as, where necessary, from their guardians. Confidentiality and anonymity were also kept in mind throughout. It was ensured that the information would only be utilized for academic purposes and the participants could leave the study at any time.

Results

Table 3. Demographic Characteristics of the participants (N=123)

Participant Group	Frequency (n)	Percentage (%)
Schools Heads	4	3.3
Teachers	40	32.5
Students	79	64.2

Table 2. shows that 123 respondents were involved in the research, which included school heads, teachers, and students. It should be noted that the biggest number of respondents were the students (64.2%), then teachers (32.5%), and school heads (3.3%).

Table 4. Teachers' Perception of Assistive Technology (N=40)

Variable	Mean	Interpretation
Use of assistive technology	2.28	Moderate
Impact on students' learning	1.84	Positive
Challenges in implementation	2.03	Moderate
Teacher training and support	2.06	Needs improvement

Table 4. indicates that teachers have used assistive technology moderately (M = 2.28). Positive impact was observed in terms of the learning of the learners (M = 1.84).

Table 5. School Heads' Perceptions of Assistive Technology (N=4)

Variable	Mean	Interpretation
Availability of assistive technology	1.50	Limited availability

Table 5. reveals restricted access to assistive technology in schools (M = 1.50).

Table 6. Summary of Regression Analysis

Predictor	Outcome variable	B	R ²	p- value	Interpretation
Assistive Technology	Students' Learning	0.844	0.712	< .001	Significant positive effect on student learning

Table 6. indicates that there is a significant association between assistive technology and learning outcomes ($\beta = 0.844$, $p < .001$). Seventy-one percent of the variations in learning are explained by the variable of assistive technology ($R^2 = 0.712$).

Table 7. Summary of Students' Interview Findings (N=79)

Theme	Key Findings
Types of assistive technology	Adjustable desks were the most commonly used assistive technology and then, wheel-chairs.
Learning	Most students reported that assistive technology made learning easier.
Challenges	Students highlighted the limited availability of advanced assistive technologies and difficulties in independent learning at home.

Table 7. indicates that adjustable desks were the most frequently used assistive technologies. Most of the students believed that assistive technology helped improve their learning, but had insufficient resources for advanced technology.

Findings

- The research investigated the impact of assistive technology on learning among students with disabilities enrolled in special education schools. The results of the investigation found out that assistive technology had a positive contribution in facilitating learning by providing accessibility to instructional materials, classroom involvement and academic assignments.
- A moderate usage of assistive technologies in schools and a positive effect of the technology on learning of learners was perceived by teachers in the schools. Results from regression analysis show that assistive technology positively predicted learning outcomes of the learners ($\beta = 0.844$, $p < .001$). About 71.2% of variance of learning outcomes was predicted by the technology ($R^2 = 0.712$).

- The results show that basic assistive technologies such as desks that could be adjusted according to need and other mobility devices were present in the schools whereas advanced assistive technologies were not present. Students interviewed felt that assistive technology made academic exercises easy for them and also allowed their involvement in learning exercises.
- Challenges identified include inadequate assistive devices, limited training of teachers in assistive technology, lack of technical assistance and resource problems. In general, the findings show that assistive technology plays a significant role in learning of learners with disabilities but needs better resource and assistance system.

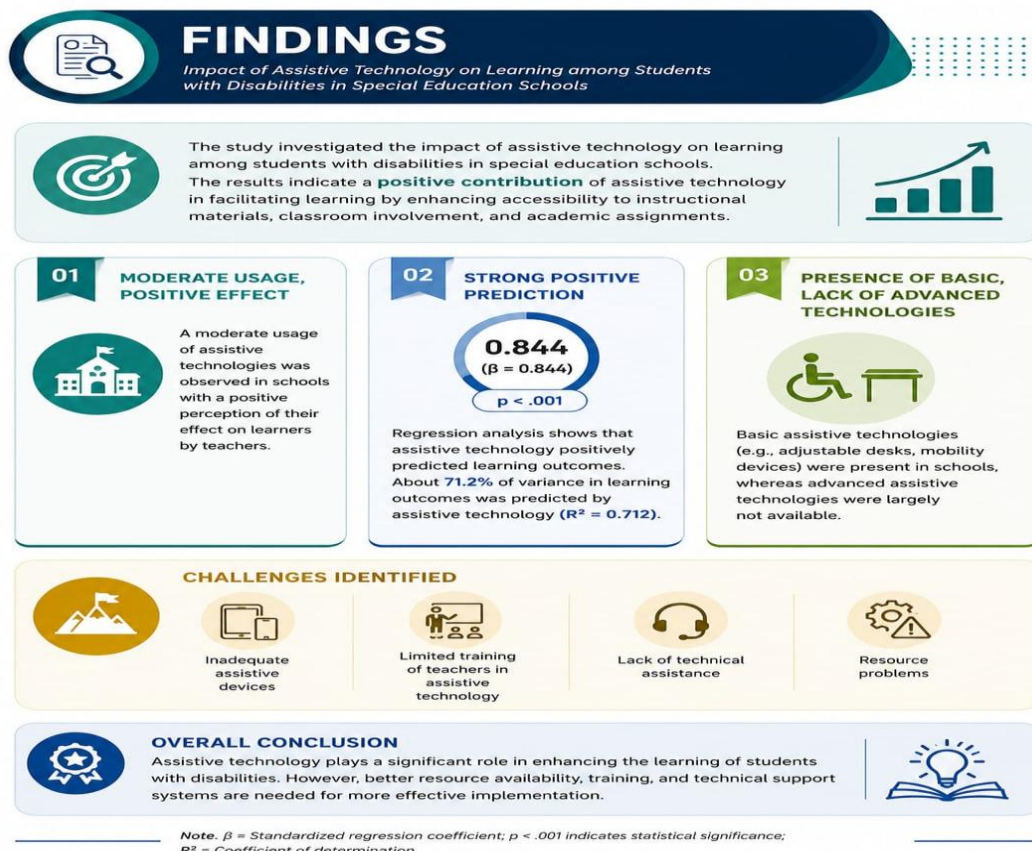


Figure 3. Findings

Discussion

The results obtained from the current study reveal that assistive technology plays a crucial role in promoting the learning processes of students with disabilities. The significant predictive impact of assistive technology on learning outcomes shows that with the use of technological means, students can get access to proper educational processes and increase their educational engagement. These conclusions correspond to other researchers who showed that assistive technology positively affects the curriculum accessibility and performance of disabled students (Ali & Faiz, 2022; Hanifah et al., 2025; Nazir et al., 2024).

The main point is that schools mostly provide basic assistive technology solutions, and advanced assistive technology is used rarely. This conclusion can be explained by the general financial conditions of many educational institutions in developing countries where the lack of money, resources, and technological infrastructure makes it difficult to use advanced technology solutions. The same results have been revealed by Hameed and Manzoor (2019) who stressed systemic problems connected to inclusive education in Pakistan.

Positive perceptions of the studied students about the use of assistive technology support other studies which concluded that with the help of technological means, students can participate actively in classwork and complete learning tasks confidently. Besides providing additional functions, assistive technology creates a climate for inclusive education where all learners can work with educational resources according to their specific needs.

Thus, it should be noted that the listed challenges show that the effective use of assistive technology requires competent teacher preparation and technical assistance, in addition to availability. It means that in order to ensure effective learning processes, it is necessary to conduct special teacher training programs and develop other supporting mechanisms.

Directions for Further Research

Further research needs to conduct longitudinal studies in order to investigate the impact of assistive technology use on the learning outcomes of students. Larger sample sizes and regional differences within Pakistan should be considered in order to get more information on the application of assistive technology in special education. Future researchers could look at advanced digital assistive technologies, training programs for teachers, and support systems to enhance special education institutions' use of assistive technology.

Conclusion

This study examined the impact of assistive technology on the learning of impaired students in special education institutions. The results of this research demonstrate that assistive technology improve students' learning process since it makes their participation in classroom activities better, provides them with better access to instructional materials, and helps complete educational tasks. However, lack of advanced assistive devices, inadequate training, and poor implementation of assistive technology are barriers to the effective use of it.

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