

Assessing the Effectiveness of AI-Powered Assistive Technologies in Inclusive Classrooms: A Global Perspective

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Abstract

The usefulness of AI-powered assistive technology (ATs) for teaching kids in inclusive classrooms has been critically examined. By incorporating a variety of technological tools and strategies to give pupils a customized learning experience, assistive technology (AT) has been found to have a significant impact on teaching impaired children. Relevant peer-reviewed publications and articles have been chosen for thematic analysis. Themes have been developed in a manner that directly responds to the goals of the research and provides a thorough explanation of them. Thus, this study has examined the benefits, drawbacks, particular tools and methods, and difficulties of utilizing AI-driven AT. The importance of AI-powered AT in creating a classroom of inclusivity has been proved despite its challenges.

Keywords: AI-Powered Assistive Technologies, Inclusive Classrooms, Personalized Learning Experience, Educator's Training.

Introduction

Background

AI has demonstrated the potential to offer personalized support for learners to fulfil their needs. According to Kumar et al. (2023), using AI-powered technologies in a classroom has become widespread. It helps enhance the effectiveness of an inclusive classroom, such as customized learning opportunities and audio-visual study materials for students. Teaching faculty in such classrooms is important in facilitating AI-powered educational practices. Similarly, Almufareh et al. (2024) have also expressed that AI-based platforms are becoming a core component of the education industry as they provide a student-centric learning environment. AI-powered tools such as text-to-speech, real-time transcription services, user navigating systems, and Brain-Computer Interfaces (BCIs) are used in an inclusive classroom (UNICEF, 2024). Other assistive technologies such as graphic organizers, Augmentative and Alternative Communication (AAC), mind mapping software, and the respective can also be used in a classroom. As a result, the implementation of such technologies provides an advanced learning experience for students.

Problem of the statement

Despite the multiple benefits of using AI-driven assistive technologies (AT) in an inclusive classroom, it comes with a major challenge of difficulties in obtaining AT equipment (Almufareh et al. 2024). It is coupled with the issue of a lack of training among the users such as the teaching faculty and other educators. Consequently, it often leads to a negative attitude among educators due to insufficient training for them. Assistive technologies are majorly used for students having special educational needs (SEND). For instance, the government of England reported that 1.5 million pupils in England had SEND in 2022 where AI-powered AT is recommended for use in their classrooms (UNICEF, 2024). The problem of statement is worded “**Assessing the Effectiveness of AI-Powered Assistive Technologies in Inclusive Classrooms: A Global Perspective**”

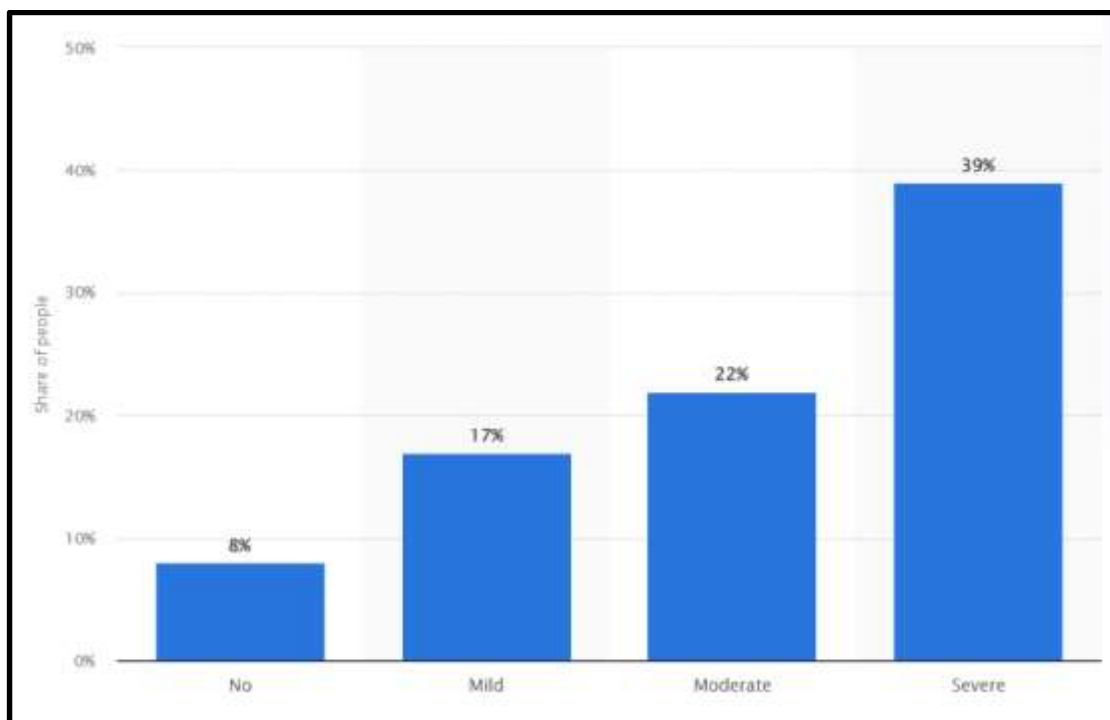


Figure 1: Number of disabled people using AT in India in 2019

(Source: Influenced by Minhas, 2023)

A survey was conducted by Minhas in 2019 in India regarding the usage of AT in education for disabled people. The survey has found that AT could help only 39% of severely disabled people along with 22% of moderately disabled (Minhas, 2023). The effectiveness of AT can be low due to inadequate equipment, infrastructure, and funding in India. Similarly, approximately 2.5 billion global people currently need assistive technologies in education for a better outcome (UNICEF, 2024).

Aims and Objectives

The research aims to critically assess the effectiveness of using AI-powered assistive technologies in an inclusive classroom.

The research objectives are mentioned below.

RO1: To determine the impact of AI-powered assistive technologies in creating an inclusive classroom

RO2: To identify the AI-powered assistive technologies that can be used in an inclusive classroom

RO3: To recognize the challenges of implementing AI-powered assistive technologies in an inclusive classroom

Review of previous research

The impact of AI-powered assistive technologies in global inclusive classrooms

Teaching techniques have considerably changed with the usage of AI-powered AT in an inclusive classroom environment. As stated by Sharma et al. (2023), AI helps educators understand different methods to educate students with special needs. The right method can be identified by educators with the help of AT which assists in determining the right communication channel to interact with students as well. For instance, AT makes inclusive learning a reality that helps disabled children, with cultural barriers, or language barriers to be eliminated from the classroom (Julien, 2024). As a result, the bridging gaps between educators and students can be erased with the application of AT in classrooms.

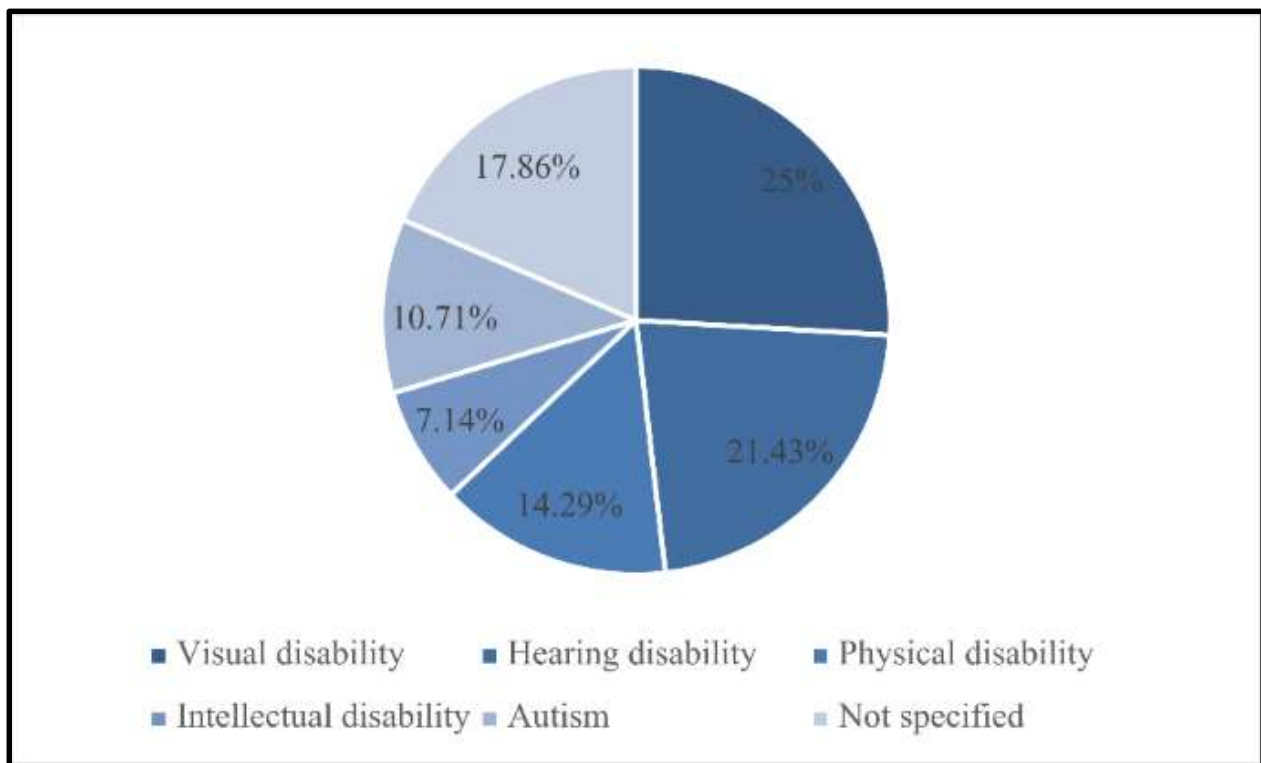


Figure 2: Assistive Technologies for inclusion of disabled students

(Source: Influenced by Fernández-Batanero et al. 2022)

Figure 2 presents the graphical representation of the survey results that have been conducted by 2024. It has been shown that AT has been proven to be beneficial for 25% of students with visual disability and 21.43% of students having hearing disabilities (Fernández-Batanero et al. 2022). The study has also depicted that AT is beneficial for improving the teaching-learning process by 13.51% along with the acquisition of social skills among students by 11.49%. Therefore, the impact of AT is majorly seen to be positive with its proper implementation.

The identification of the best AI-powered assistive technologies for inclusive classrooms

Various AT tools and techniques are globally used in inclusive classrooms that result based on their utilization and other factors. As per the view of Barua et al. (2022), speech-to-text software is mostly used

as an effective tool of AT that is also known as dictation software. It is designed to convert spoken language into written texts and it helps students with mobility impairment or dexterity challenges. AI-powered Object Recognition, Intelligent Navigation Systems, and Advanced OCR can be used for students having visual impairment (KHAZANCHI & KHAZANCHI, 2024). Such tools can process data from various sensors that can guide impaired students. On the other hand, sign language translation, sound recognition, and real-time speech-to-text can be used for students having hearing impairment (Garg & Sharma, 2020). Other than that, Machine Learning, Deep Learning, and Natural Language Processing (NLP) are used for speech recognition, sentiment analysis, and the respective.

The problems faced while using AI-powered assistive technologies in inclusive classrooms

Technological difficulties, pedagogical issues, database limitations, and poor connectivity are the major issues that cause challenges in implementing AI-powered AT in classrooms. As mentioned by Almufareh et al. (2024), educators often lack the technical expertise which is the biggest challenge of implementing AT in inclusive classrooms. Moreover, integrating AI in classroom activities might be challenging due to the traditional educators' practices. Global educational institutions lack in providing technological training for educators which causes further challenges in its implementation (Julien, 2024). A lack of funding for AT establishment is a great challenge as is evident in Africa. Global funding in African AT is only £200k in 2024 which makes AT inaccessible for 135 million Africans (Global Disability Innovation Hub, 2024).

Research design

Research method

A secondary qualitative method has been followed in this research as it is beneficial in understanding the previous and current utilization of AT in education. A comparative analysis has been conducted along with finding the current trends of tools and technologies that are used as AT in inclusive classrooms (Paul et al. 2021). As a result, an in-depth insight into the application of AI-driven AT for inclusive classrooms has been obtained by choosing this research method.

Data collection process

Authentic databases such as ProQuest, ResearchGate, and ScienceDirect have been accessed for data collection purposes. Only peer-reviewed journals and articles on AI-powered AT for education have been collected to extract information.

Table 1: Boolean search results

Keywords	AND/OR	Keywords	AND/OR	Keywords	Search results
Assistive technologies	AND	Inclusive classroom	OR	Disabled children learning	ProQuest=41 ResearchGate=22
AT tools	AND	Speech-to-text software	OR	Sign language translation	ResearchGate=14 ScienceDirect=56
Benefits of AT	OR	Learning experience	AND	Effectiveness of AT	ScienceDirect=23 ProQuest=90

(Source: Influenced by Abbasi et al. 2022)

Table 1 presents the most effective keywords that have been applied while searching for relevant journals and articles in databases.

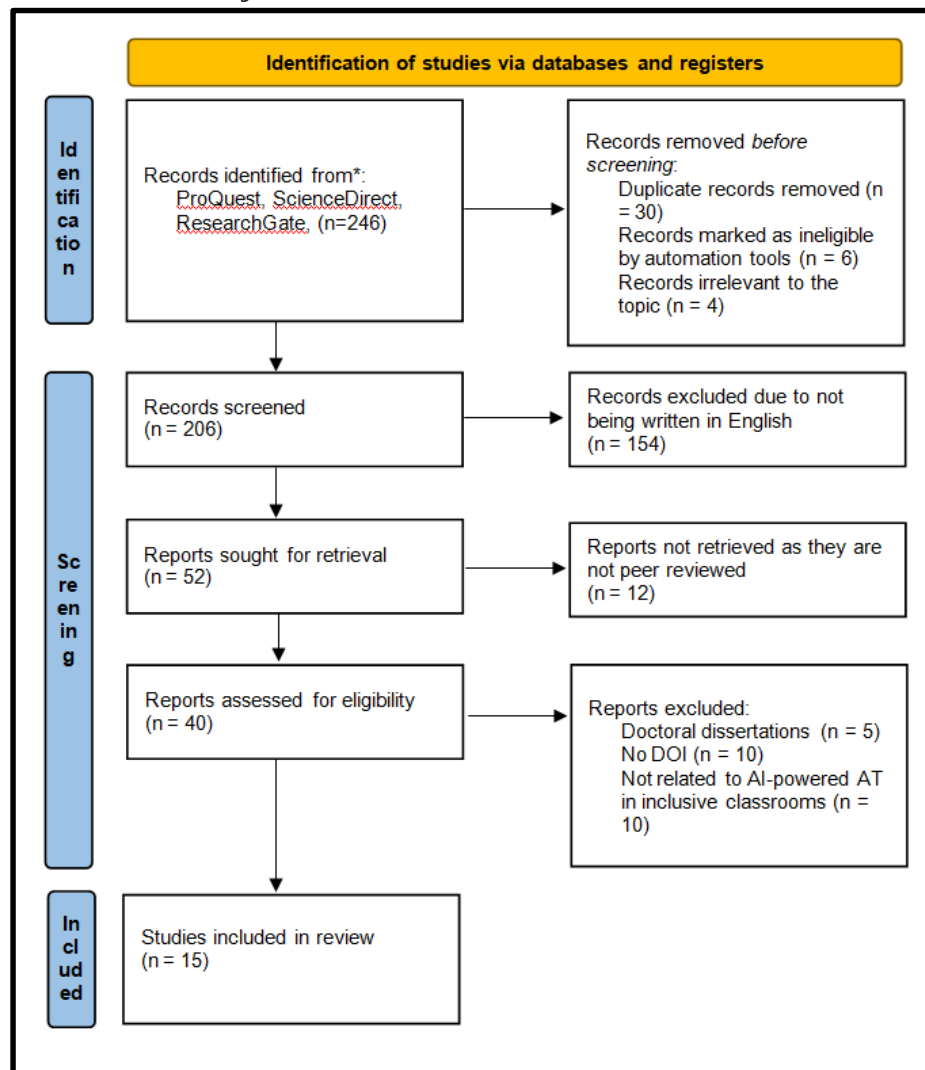


Figure 3: PRISMA diagram
(Source: Influenced by Martins et al. 2023)

Figure 3 mentions that a total of 15 peer-reviewed journals and articles have been selected for the data analysis section of the study. It has worked as a screening method to select previous studies only eligible for this particular study.

Data analysis process

The data analysis process of this research has chosen a systematic review method to critically examine the secondary data available. A thematic analysis has been conducted by forming three themes that meet individual research objectives (Paul et al. 2021). Existing information on AI-powered AT's application in inclusive classrooms has helped in critically discussing its benefits and drawbacks. Thus, this data analysis process has worked effectively for this study context.

Results

Table 2: Axial coding

Authors	Codes	Themes
Ayeni et al. (2024) Yang & Weng (2023) Pawar (2023) Montanucci & Peconi (2023) Zohuri & Mossavar-Rahmani (2024)	Learning experience, adaptive learning platforms, immersive learning experience	“Theme 1: AI-powered AT provides a personalized learning experience in inclusive classrooms”
Avuclu & Koklu (2022) Anis (2023) Kumar & Nagar (2024) Iweuno et al. (2024) Deka et al. (2024)	Transcription capability, accessibility needs, education tool, flagship technology	“Theme 2: Speech recognition software is majorly used as an AI-driven AT tool in inclusive classrooms”
Damyanov (2024) Joshi et al. (2021) Winter et al. (2021) Whalen (2020) Khatoony & Nezhadmehr (2020)	Student engagement, educator’s training, skill improvement, integrated learning	“Theme 3: Insufficient training for educators to use AT in classrooms is the biggest challenge of using AT in education”

Analysis

Thematic analysis

Theme 1: AI-powered AT provides a personalized learning experience in inclusive classrooms

Inclusive classrooms have been revolutionized by acknowledging the use of ATs as they provide personalized learning experiences. As suggested by Ayeni et al. (2024), students with diverse abilities can benefit from ATs as they tailor instructions by adjusting learning content, difficulties of individual students, and learning pace. Furthermore, AT accommodates students having disabilities by introducing multimedia support, speech-to-text, and text-to-speech software (Pawar, 2023). It can also collect real-time feedback by using AI-driven assessments offering immediate feedback that enables teachers to intervene promptly (Montanucci & Peconi, 2023). As a result, the individual needs of students can be catered to easily by utilizing the appropriate tools and techniques of AT.

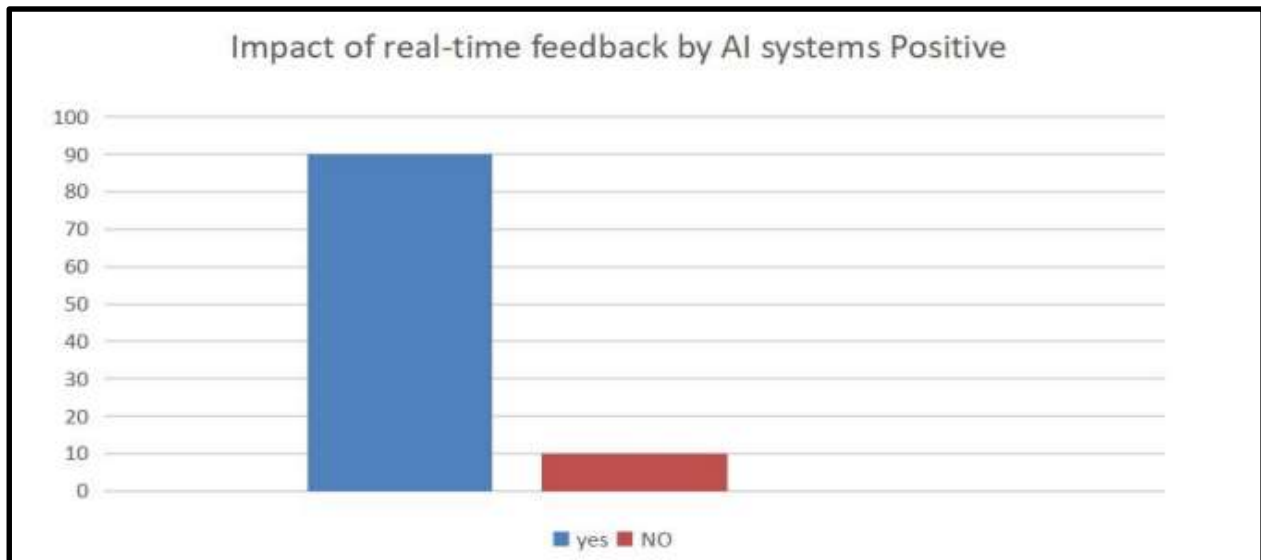


Figure 4: Impact of real-time feedback by AI systems
(Source: Influenced by Yang & Weng, 2023)

Figure 4 presents the impact of real-time feedback provided by AI systems that are widely implemented in inclusive classrooms. A survey was conducted by Yang & Weng among students of various educational backgrounds. Respondents have shared that approximately 90% of the students believe that ATs provide a perceived benefit of individualized learning journeys that can be improved by real-time feedback (Yang & Weng, 2023). It also helps in increasing engagement between educators and students which boosts the motivation of students. It also offers data-driven insights from the classrooms to help educators assess the progress of the students (Zohuri & Mossavar-Rahmani, 2024). Therefore, further instructions and personalized learning paths can be created for students.

Theme 2: Speech recognition software is majorly used as an AI-driven AT tool in inclusive classrooms

The usage of speech recognition software is widespread as an AT tool as it enhances accessibility and supports diverse learners. As commented by Deka et al. (2024), speech recognition software helps enhance writing experiences for students who have physical disabilities. In addition, this tool supports especially English Language Learners (ELLs) and non-native speakers in an inclusive classroom setting. However, as argued by Iweuno et al. (2024), students having visual impairment in an inclusive learning environment can become independent by using speech recognition methods. As a result, popular speech recognition software such as Apple Dictation, Google Docs Voice Typing, and the respective are widely used.

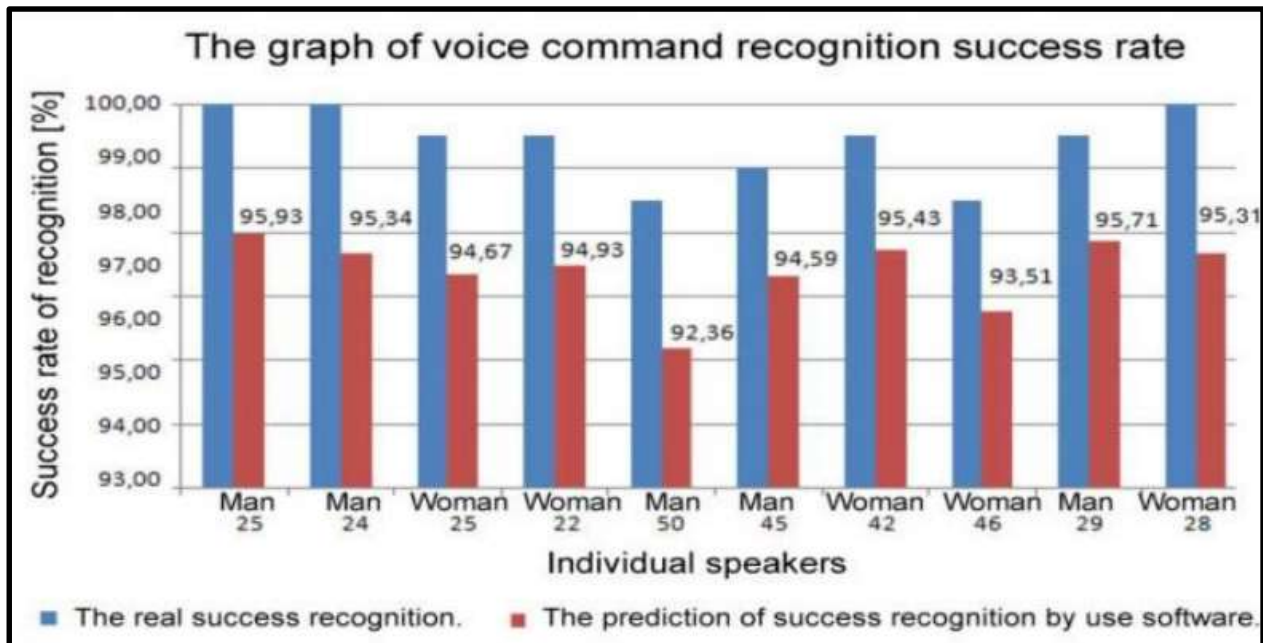


Figure 5: The success rate of voice command recognition

(Source: Influenced by Avuclu & Koklu, 2022)-

The effectiveness of voice command recognition and its success rate are presented in Figure 5. It has been shown that the prediction of success recognition by using software is 95.93% among men of 25 and 94.67% among women of 25 (Avuclu & Koklu, 2022). Hence, the application of speech recognition software is done for communication support for students having speech disorders as well (Kumar & Nagar, 2024). The engagement and participation of students can be significantly increased by using this particular tool in inclusive classrooms. On the other hand, Anis (2023) has argued by saying that teachers must be trained properly along with providing student orientation to obtain the best outcome from speech recognition software. In this way, such tools can be integrated with the existing classroom curriculum of disabled students.

Theme 3: Insufficient training for educators to use AT in classrooms is the biggest challenge of using AT in education

A lack of training for educators is the major issue in implementing ATs in inclusive classrooms. As demonstrated by Winter et al. (2021), educators seem to have limited knowledge and skills to use modern technologies in education. They do not get sufficient technical support which makes situations more complicated and educators uncomfortable (Khatoony & Nezhadmehr, 2020). Besides, teachers lack is in having pedagogical knowledge regarding the integration of AT into lesson plans. Educational institutions do not provide enough training and resources for educators which results in limited access for them (Whalen, 2020). Thus, the desired outcome for the application of ATs in inclusive classrooms cannot be obtained in educational institutions.

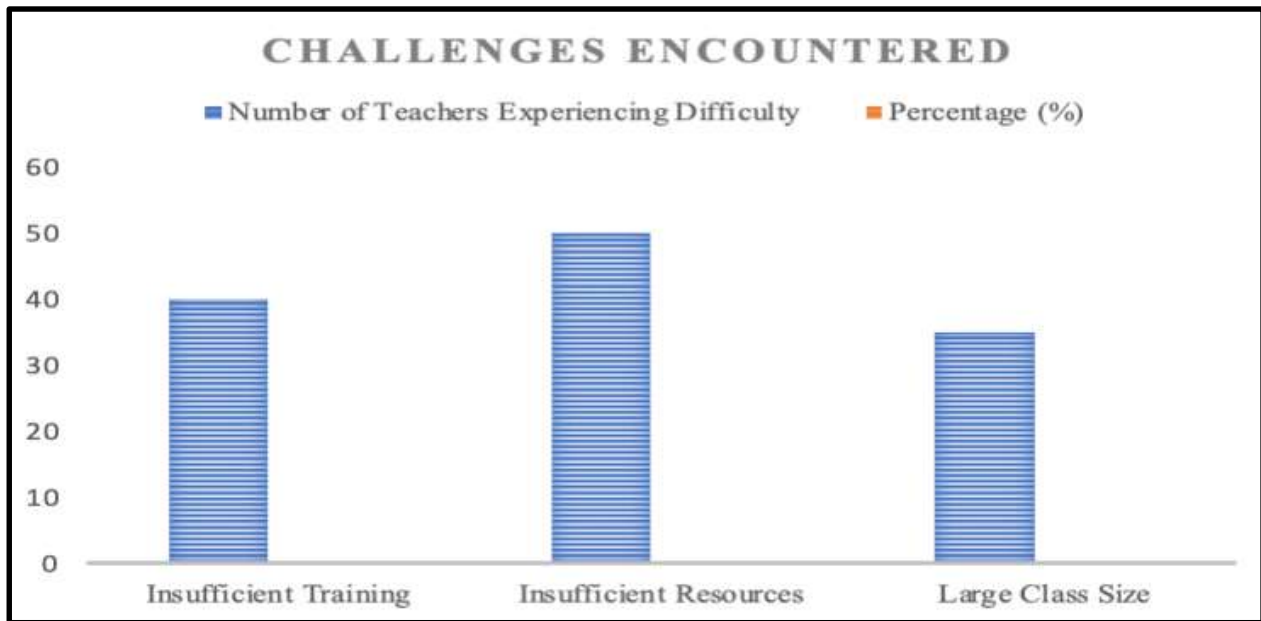


Figure 6: Challenges encountered in implementing AT in an inclusive classroom
(Source: Influenced by Damyanov, 2024)

Figure 6 is the graphical representation of the challenges that inclusive classrooms often face in using AT. In this context, it has been found that around 40% of the teachers have insufficient training according to the survey conducted by Damyanov (2024). Moreover, more than 48% of teachers lack sufficient resources and a major part has an issue of having a larger size of class. Similarly, Winter et al. (2021) have shared that a lack of skill among educators to use ATs in the classroom increases the turnover rate of educators. It leads to knowledge gaps and further technical errors are increasing due to a lack of training and support (Joshi et al. 2021). As a result, it has become challenging to redesign the inclusive classes and incorporate ATs into the existing curriculum without proper knowledge of ATs among teachers.

Discussion

The critical analysis of the research shows that AI-driven AT has become important to use in teaching in a diverse classroom atmosphere. As depicted by Sharma et al. (2023), AT can improve the classroom environment by providing a personalized learning experience for students. It can be utilized through the implementation of various software or tools and techniques as per the students' requirements. Moreover, the discussion meets all the research objectives by addressing them through the themes. For instance, speech recognition is majorly used in inclusive classes as an effective AT tool (Garg & Sharma, 2020). Google Docs Voice Typing and Apple Dictation are helpful as these tools are also widely available among students. On another note, a lack of proper knowledge regarding the methods of using AT in inclusive classrooms is the major challenge behind its implementation (Barua et al. 2022). In this way, such effective knowledge helped in meeting the formulated research objectives by discussing in-depth insights.

Conclusion

A critical discussion has been done on how effective AI-powered ATs are for educating children in an inclusive classroom. ATs are found to be mostly impactful in teaching disabled children as they help by including various technological tools and techniques to provide students with a personalized learning

experience. Thematic analysis has been conducted by selecting relevant peer-reviewed journals and articles. Themes have been formed in a way that directly addresses the research objectives and explains them with an in-depth analysis. Consequently, the advantages, disadvantages, specific tools and techniques, and challenges of using AI-driven AT have been explored in this study.

Future scope and limitations

The study has significant scope in the future as it has provided knowledge on the topic from a global perspective. Future studies will be able to obtain a basic yet concrete idea regarding the implementation of AI-powered AT in creating inclusive classrooms. Previous study inclusion has further increased its efficiency of critical discussion and will contribute positively to future studies.

The methodological selection of the research has worked as a significant limitation which can be altered in future studies. The study has followed a qualitative method which limits the usage of quantitative information that increases the credibility of a study.

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Thematic analysis

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