Technology and Disability: Building Communication and Creating Opportunities?

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ABSTRACT

Physical limitations, visual impairments, hearing impairments, and mental disorders can all create barriers to accessing public facilities, transportation, and information for those with disabilities. This necessitates greater efforts from both society and the government to create an inclusive environment that reduces these obstacles through the utilization of technology. Hence, this research aims to analyze how technology can be leveraged by people with disabilities to participate in various activities and lead productive lives akin to those of their peers. The methodology employed, based on this literature review, involves seeking citations concerning technological advancements and underscoring the implications of technological development in aiding the activities of people with disabilities in accordance with their specific needs. This analytical study provides crucial insights into the imperative for solutions to address the challenges faced by people with disabilities across diverse domains, including accessing public facilities. We discern broader opportunities for the development of technology that aids people with disabilities across multifaceted aspects of life, such as specialized software, adaptive hardware, and applications facilitating communication.

Keywords:
Facilities for disabilities; inclusive education; people with disabilities; technology for disabilities

1. Introduction

The World Health Organization (WHO) estimates that there are approximately 1.3 billion people with disabilities worldwide. This figure accounts for roughly 16% of the total global population [1]. According to a survey conducted by the Central Bureau of Statistics in Indonesia, the number of people with disabilities reached 22.97 million, or about 8.5% of the total Indonesian population of 278.69 million. This group faces social challenges due to limitations in communication and accessing information in their surroundings. Communication and information play fundamental roles in human life [2, 3]. The obstacles faced by people with disabilities, especially children with disabilities, tend to increase as societal pressures escalate [4,5]. These constraints on children persist due to prevailing societal biases towards disabilities. This understanding indicates that the sources of the social issues

faced by children with disabilities actually stem from society itself, imposing pressures and limiting the potential of these children [6,7].

One strategy to address the social challenges faced by children with disabilities is through the implementation of inclusive education [7-15]. Education plays a crucial role in ensuring the social well-being of children [16], including those facing physical or mental challenges. Efforts to achieve national educational goals still encounter obstacles. An exclusive approach within the education system leads to limited access for children with special needs to obtain education. This understanding of exclusivity further exacerbates the situation where less privileged children with specific needs become increasingly isolated and underserved.

Inclusive education refers to an educational model that provides opportunities for students with special needs to learn alongside their peers [17]. The establishment of inclusive schools aims to mitigate the impact arising from exclusive attitudes within education [18]. Inclusive education also offers opportunities for children with special needs and less privileged backgrounds to receive education. The concept of inclusive education involves adjustments and modifications in content, teaching approaches, structures, and learning strategies, with the goal of enabling all children to meet their needs according to their age group [19]. Inclusive education can also be seen as a manifestation of attention to the diverse learning needs of children with special needs, with the hope that teachers and students feel comfortable in an environment rich in diversity [20,21]. Furthermore, diversity is regarded as an opportunity that enriches the learning process rather than a problem. The inclusive education approach will also undergo gradual evolution in accordance with the realities encountered in its practice, necessitating continuous adaptation and development to address emerging educational challenges [22,23]. Challenges in the field of education need to be resolved in order to expand access for all children with disabilities.

The current technological advancements have a positive impact on daily life, as various activities have become simpler and more efficient thanks to technological progress [24,25]. Actions that were once deemed impossible can now be easily carried out. Similarly, for those with physical or mental limitations, some people perceive that independence and the execution of daily activities for people with disabilities are difficult to achieve as compared to the general population. Nevertheless, assistive technology has the potential to provide ease for people with disabilities in performing a variety of activities [26-32]. Assistive technology encompasses various devices or tools that have been modified or unmodified, and is used to enhance and support the activities of people with disabilities [33,34]. Therefore, to diminish the dependence of people with disabilities on others, it is necessary to learn communication methods and self-reliant activities by leveraging technological advancements. Considering these considerations, this research will explore the latest technological developments that could be utilized by people with disabilities.

2. Methodology

The pedagogical approach that influences the structure of educational curriculum needs to be customized by educational institutions, particularly in the context of people with disabilities, by harnessing the advancements in current technology [35,36]. We conducted a descriptive review outlining the scope of the literature review based on several references. These articles were sourced from credible online literary outlets. This approach was a mapping procedure utilized to comprehend the research domain prior to conducting a systematic review. The coverage analysis din not require quantitative data evaluation; however, the coverage synthesis was qualitatively oriented [37]. Detailed information regarding how to search documents is explained elsewhere [38,39].

In the available literature, we had identified five articles discussing a compilation of online references on current technology that were cited to support activities for people with disabilities. These articles were selected from the last three years and were summarized here as they had been published in prominent journals highlighting the application of technology to enhance the self-confidence of people with disabilities in interacting with their surrounding environment [40,41].

Articles published from 2021 onwards were included in this analysis to ensure the freshness of information and to reflect the utilization of cutting-edge technology in supporting people with disabilities. Sources from online databases were systematically examined, and supplementary information were sought through sources deemed credible. A list of generated references was included and filtered to meet the established criteria in order to broaden the search scope. When conducting a systematic review, it was highly improbable to encompass all relevant literature. Hence, the search was directed towards review articles by fellow experts utilizing keywords such as: 'technology for people with disabilities'; 'digital technology for people with disabilities'; 'enhancing abilities of people with disabilities'; and 'disability and technology'. The search was confined to English-language articles published between 2021 and 2023. The document types were restricted solely to 'articles' and 'reviews', eliminating duplicate documents. Articles not pertinent to the utilization of technology for people with disabilities were excluded from the search process.

3. Results

The implementation of technology plays a significant role in enhancing the quality of life for people with disabilities by providing broader access to information, communication, and opportunities. Technology aids in overcoming physical and communication barriers they might encounter, enabling them to learn, work, and engage in various activities more independently. Through the adoption of inclusive technology, people with disabilities can harness their potential, establish better connections with their environment, and reduce gaps in socialization. In the scrutinized literature, five articles were identified by examining online reference lists of citations related to the utilization of technology that can assist people with disabilities. The articles presented in Table 1 were selected due to their publication in reputable journals and their involvement in employing technology to aid people with disabilities.

The study conducted by Cochran [42] provides a unique contribution to transportation research by qualitatively investigating how and why people with disabilities utilize app-based ride-hailing services. Based on an in-depth interview study involving 32 individuals with disabilities, the findings demonstrate that attitudes towards app-based ride-hailing usage depend on respondents' previous experiences with transportation and smartphones. For some, this experience is contingent on how long an individual has lived with a disability. These findings highlight barriers and facilitators to app-based ride-hailing service usage, which has implications for policies and programs aimed at enhancing accessibility for people with disabilities. According to the participants, ride-hailing services are perceived as more affordable, reliable, and convenient. Key considerations include cost, affordability within their budget, reliability, and convenience aligned with their schedules.

The second article [43] from Table 1 explores the utilization of technology within the classroom setting with the aim of creating a significantly distinct experience for people with disabilities. This technology enables students facing communication challenges to engage with classroom content and materials, as well as communicate with peers and teachers. Several educators in these classrooms have observed that specific features of digital tools contribute to student engagement and empower them to reinforce their connections with the curriculum and school activities. Additionally, digital technology can be practically employed to assist students in staying organized through reminder

applications and calendars regarding their activities and schedules. Moreover, we are cognizant that the successful integration of new technology necessitates a certain level of comfort, knowledge, and skill. Nevertheless, the sluggish uptake of technology underscores that there persist challenges that could impede the continued use of technology within the classroom setting, particularly when it involves people with disabilities.

Table 1
Implications of the technology development for people with disabilities

Source	Issue	Method	Conclusion
Cochran [42]	The provision of app-based ride-hailing services by transportation network companies to be accessible for wheelchair users.	Qualitatively investigating how and why people with disabilities utilize ride-hailing services, and conducting interviews with 32 individuals with disabilities.	These findings highlight barriers and facilitators to the utilization of transportation networks, which have implications for policies aimed at enhancing access to app-based ride-hailing services among people with disabilities.
Rizk *et al.,* [43]	The integration of digital technology in the classroom to foster new interactions and explore the participation of students with disabilities in order to enhance academic performance outcomes.	This paper utilizes qualitative data from six school boards, including 27 classroom observations and interviews with teachers, to explore the role of digital technology (namely, robotics, iPads) involving students with disabilities	Digital technology can play a significant role in enhancing student engagement by providing support and access to classroom learning, through both literal and figurative means, thus enhancing interactions among students with disabilities.
Horton [44]	Exploring the design and development of tablet-based musical instrument tool for people with disabilities in the context of music education.	Designing tablet-based musical instruments intended for people with disabilities in the context of music education.	By designing tablet-based musical instruments, fostering the creative experiences of students with disabilities and enhancing their interactions within their peer groups, even though the utilization of songs, melodies, and rhythms requires further exploration.
Mark *et al.,* [45]	Digital assistance system support for the interaction of individuals with disabilities enabling inclusion in the labor market.	A social enterprise in collaboration with stakeholders, companies, and employees identifies the capabilities of individuals with disabilities to engage in assembly processes within the Smart Mini Factory of the Industry 4.0 laboratory	People with disabilities can be involved as operators of a specialized assistance system for disabilities. Furthermore, further observation is needed regarding the mental aspect, which can be measured using technological devices such as electroencephalography.
Paiva *et al.,* [46]	Presenting a mobile application that functions as navigation to provide information on taxi points, parking spaces, and points of reference in a location for people with disabilities.	Utilizing the Dijkstra algorithm, which is an algorithm for finding the shortest path between nodes in a graph, serving as a navigation tool for people with disabilities.	The navigation system using the Dijkstra algorithm has been successfully developed, but it still requires further testing and necessitates approval from the city council for its implementation.

In the other article [44], the field of music technology holds substantial potential for interactive experiences among students with disabilities [47]. The methodologies employed in this study delve into the design of digital musical instruments that offer practical insights for technology developers

aiming to facilitate creative expression and interaction for students with disabilities [48,49]. The emergent themes are subsequently examined through a design framework to gain a deeper understanding of the students' capabilities as users of digital music tools, the teachers' knowledge, and the designers' expertise within music projects. Although this research incorporates musical styles akin to those commonly used in the classroom, further exploration is warranted regarding the utilization of songs, melodies, and rhythms that are more familiar to people with disabilities [50,51].

The subsequent article [45] observes workers in the production sector, highlighting the significant diversity among user groups with equally diverse needs. The implementation of digital assistive systems takes place in collaboration with social entrepreneurs, where people with mental or physical disabilities are predominantly engaged in assembly tasks within the company [52,53]. The necessary skills of the workers are generally gathered through interviews involving stakeholder associations, companies, and employees. In conjunction with the supervisory staff of a social enterprise, the requisite abilities for disabled workers are identified and compared with the skills necessary for the assembly processes. Subsequently, an experiment is conducted using the digital worker assistance system to assess its effectiveness, and it turns out that people with disabilities can be involved by considering the mental aspects [54,55].

In the last article [46], the developed application was intended for persons with permanent or temporary mobility constraints, with the aim of providing them with information regarding taxi points, parking areas, and city focal points. It offers the possibility of navigating to these locations using optimized algorithms tailored to specific segments (such as the deaf, the visually impaired, and others), determined for each route. This article explains that the navigation system was built successfully but still requires further testing and permits from the local government [56,57].

Investigating the supporting and inhibiting factors of technology implementation for people with disabilities holds undeniable significance in ensuring the success and positive impact of inclusion efforts [58-60]. By comprehending supportive factors such as the development of inclusive technology, supportive regulations, public awareness, and active responses from people with disabilities, we can establish a robust foundation to optimize technological accessibility. Conversely, identifying inhibiting factors like limited technology understanding, financial challenges, inadequate training, and insufficient accessibility standards enables us to design effective solutions to overcome these constraints [61-67]. Several supporting and inhibiting factors of technology implementation for disabilities can be observed in Table 2.

Overall, the success of implementing technology for people with disabilities is significantly influenced by various supporting factors, such as the availability of appropriate technology, easy accessibility, reliable training and technical support, as well as sustainable innovation. However, it is acknowledged that challenges such as limited technological literacy, a lack of awareness about aiding people with disabilities, and regulatory barriers can impede progress in empowering disabled persons through technology. Therefore, collaboration among users, designers, government entities, and society as a whole is paramount to creating an inclusive ecosystem and driving the development of future technology that is more disability-friendly.

Table 2
Supporting and inhibiting factors of technology implementation for disabilities

Supporters	Restrictions
i. Young people with disabilities find it easier to comprehend and implement technology.	i. Elderly people with disabilities find it challenging to understand technology.
ii. Virtual reality and web-based assistive tools can help provide enjoyable and motivating programs for people with disabilities.	ii. People with disabilities who have relatively new impairments struggle with using app-based transportation due to adapting to their newfound independence.
iii. They can offer novel ways to structure interactions facilitated by technology.	iii. The availability and quality of accessible wheelchair-friendly ride-hailing services are insufficient.
iv. New technology has introduced innovative mechanisms for involving people with disabilities in modern interactions.	iv. Government approval is required if the developed application is to be implemented in public spaces.
v. Engaging and enjoyable technological interactions can trigger positive emotional responses among people with disabilities.	v. The slow adoption of technology is due to parties that do not yet comprehend its utility.
vi. Educators have become more conscious of creating engaging classroom interactions with students with disabilities to enhance their digital skills.	vi. Inadequate training hampers the effective utilization of technology.
vii. Technology can provide insights into the types of knowledge and skills required to support activities for people with disabilities.	

4. Conclusions

An important finding of this research emphasizes the necessity of collaboration among various stakeholders, ranging from close associates, educators, governmental and private entities, to generate optimal ideas for people with disabilities through the utilization of technology. Technology holds significant potential to positively transform the lives of people with disabilities. Factors such as the availability of suitable technology, effective accessibility, supportive training, and user participation are pivotal in achieving success. Nevertheless, challenges like lack of awareness and regulatory barriers also need to be addressed to ensure technology's maximal benefits. Investigating the supportive factors in technology utilization will guide the strategic steps required to realize greater inclusion and more effective empowerment for people with disabilities. Through collaborative efforts among diverse parties, we can establish an inclusive and empowering environment for people with disabilities by harnessing advanced and sustainable technology.

Acknowledgement

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