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Rapidly Growing Landscape of Educational Apps for Children with Disabilities: Addressing Availability, Accessibility, and Persistent Challenges

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***Abstract*:-**The number of children with special needs is quickly increasing around the world, but many schools and universities are failing to meet their educational demands. As a result, a huge proportion of impaired students drop out of high school or university. Educational applications have the potential to improve accessibility and e-inclusion in educational environments. Educational apps are rapidly becoming a necessity in our daily educational activities. In this article, it has been proposed that how educational apps are useful for disabled children. The use of educational apps is rapidly growing. Today when a normal child is using the advantages of these apps. The use of these apps is also vital for disabled children. Parents and guardians are worried about their disabled relatives, and how to educate them. In this article, we have discussed the availability of different types of educational apps for different disabilities and also examined the accessibility guidelines for developing educational apps. Based on the introduction of educational Apps, this paper discussed the opportunities and challenges educational Apps face: Accessibility features, individualized learning, communication support, motor skill development, emotional well-being and sensory integration, create good conditions for the development of educational Apps, at the same time, the imbalance of development, poor quality, lack of attention and emotional development and security issue the restriction factors of the development of educational Apps.

***Keywords*:** Educational Apps, Children with Disabilities, Accessibility, Availability

1. Introduction

Children who need special education need self-care skills, basic skills, communication skills, business skills, social skills, and study skills in their post-education life(Karanfiller et al., 2017). For this reason, it is important to teach every skill that plays a role in the educational processes who need special education. With the rapid development of mobile technologies such as smartphones and tablets, educational apps have also become popular. This rapid technological development is believed to provide an excellent opportunity to improve the independence of children with disabilities. However, it can also be a source of social inclusion(Korczak & Zwierzchowska, 2020). Today, using free time for learning is the central requirement in mobile education. With smartphones, tablets and other mobile terminals equipped with applications, the learning process from mobile terminals is

becoming a new trend, educational apps are the new direction and growth of mobile education(Zhang et al., 2015). The contribution of mobile apps to the teaching-learning process is only possible through the development of effective course software with special needs children. Certain hindrances such as skimpy built-in accessibility options, for example, can limit the smart devices among this vulnerable population of children. Therefore, the functionality and practicality of mobile apps should be considered.

Mobile apps are only a few years old since their birth, but their speed of development and impact on people's lifestyles are amazing. The first mobile app was launched by Appel Crop in 2008. Today smartphone and tablet desktop educational apps, contain almost everything such as shopping, entertainment, payment, learning and so on. The portable mobile app perfectly matches the characteristics of the modern moving and fragmented social life of has made people's lives, work and study more convenient, and information processing mode at the blinking eye is expanding and deepening in various field stations.

What impact do mobile applications have in the field of education with children with special needs? All the technology required to transform industries through software is finally working and can be deployed on a global scale. On the other hand, accessibility refers to the barriers between the user's communication and the educational application (*W3C Hispano – Chapter for Spanish-speaking Countries*, 2023). It refers to the design of an educational application that allows users to perceive, understand, navigate and interact with the application while at the same time providing content(Luis Pérez Medina et al., 2019). By March 2023, the total number of educational apps in India was more than 50,0000, and educational apps were India's third most popular category (*Statista*, 2022).

The popularity of educational apps in special education has contributed to the new system of learning, the use of smartphones, tablets, and mobile devices to study any time anywhere. At present, the apps focus on normal student teaching, preschool classes to higher education but less focus on students with disabilities. There are different types of disabilities or disorders in different people. Some people are deaf, some are blind, some do not have legs, and some are without arms etc (S. Okazaki,2009). Because of these types of disabilities, most people with disabilities are dependent on their parents or guardians. Parents or guardians sometimes want to get rid of them of these rights. Some solutions will be discussed in this article if we try to train these disabled children in our mobile app proposal. The lives of these disabled children and their carers become more comfortable.

2. Availability of Educational Apps for Children with Different Types of Disabilities

Today every smartphone and mobile phones have a few sensors, for example, a microphone, camera, speaker, digital compass, accelerometer etc(Lane et al., 2010). Senser programmers create a large amount of application/software due to this sensor. There are a lot of software available for speech recognition. Speech recognition programs that are both effective and strong have been discovered and improved in recent years. So, converting speech/voice into text and text into speech is a miner deal. A lot of work has been done in this field(Stolcke et al., 2006). The availability of educational apps for individuals with disabilities has significantly increased in recent years**.** Mobile learning applications are becoming increasingly important in today's education due to the rapid development of mobile applications and online educational materials (Ansari & Tripathi,2017). Thanks to advancements in technology and growing awareness of the importance of inclusive education.

According to the 2011 Census, India has 1.2 billion inhabitants, with around 833 million living in rural regions. The overall number of disabled children is 164.5 million. According to the 58th round of the National Sample Survey (NSS) (July-Dec. 2002), 25% of the literate population of people with disabilities had received education up to the primary level (five years of schooling), 11% up to the middle level (eight years), and only 9% had nine or more years. Surprisingly, rural areas had greater enrolment ratios for persons with impairments aged 5 to 18 years in mainstream schools than metropolitan ones. In India, education for disabled children suffers from a lack of efficacy, infrastructure, execution, and/or other factors(Limaye, 2016). In recent studies, Soykan and Özdamlı

(2017) developed an application for students who need special education and evaluated it. Their findings state that using computers and educational software increased the interest of the students and affected their attitude positively. Educational apps can play a significant role in empowering and supporting disabled children, including those with physical disabilities in India. It can offer a cost-effective solution compared to traditional teaching methods or specialized resources. With the increasing accessibility of smartphones and tablets, educational apps can provide affordable and easily accessible learning tools for ruler-disabled children across India.

There are several educational apps available for disabled individuals that can support their learning and communication needs. These apps aim to provide accessible and engaging content specifically designed for disabled children.

Table 1 Different types of Apps for children with disabilities

From Deaf to Deaf	
Sign School	This app offers comprehensive sign language courses, interactive lessons, and quizzes to help the user learn and improve their sign language skills.
ASL Dictionary	ASL Dictionary provides a vast collection of American Sign Language (ASL) signs, enabling deaf individuals to search and learn the meaning and usage of various signs.
ProDeaf Translator	This app allows users to type in text or speak into their device's microphone and converts the input into sign language videos, facilitating communication between deaf and hearing individuals.
Story Sign	Developed in collaboration with the European Union of the Deaf and British Deaf Association, Story Sign uses augmented reality (AR) to bring children's books to life in sign language, making and accessible for deaf children.
Hand Talk	Hand Talk is an app that uses a 3D avatar to translate text and spoken languages (Libras), making communication more inclusive and convenient for the deaf community in Brazil.
From Deaf to Blind	
Be My Eyes	This app connects blind and visually impaired users blind and visually impaired users with sighted volunteers through video calls, enabling them to receive visual assistance for various tasks.
Braille Tutors	An app designed to help individuals learn and practice Braille, which is a tactile reading and writing system used by the blind.
Seeing AI	Developed by Microsoft, this app uses artificial intelligence to provide audio descriptions of the user's surroundings, read text, recognize objects, and identify people.
Braille Translator	This app allows users to type or scan text and convert it into braille, helping blind individuals access written information
From Blind to Deaf	
Tactile Feedback	The app can provide tactile feedback through vibrations or haptic technology, allowing users to feel different elements and interactions within the app.
Sign Language Integration	The app can incorporate sign language videos or animated avatars to provide visual communication for users who are deaf. These videos can demonstrate concepts, instructions, or explanations in sign language.

Audio Description	For blind users, the app can offer audio descriptions of visual elements, including images, graphs, or diagrams, ensuring that they can understand and content through audio cues.
Multi-Model Learning	The app may employ a combination of visual, auditory and tactile modes of learning to cater to users' diverse needs. It could include interactive activities, quizzes, or games that engage different senses simultaneously.
From Autism Spectrum disorder (ASD)	
Proloquo2Go	This is a powerful augmentative and alternative communication (AAC) app that helps nonverbal individuals with autism to communicate. It provides a customizable grid of symbols and allows users to construct sentences by selecting the appropriate symbols.
Pictello	Pictello is a visual storytelling app that can be used to create social stories, visual schedules, and personal narratives. It uses pictures, text, and recorded voice to help children with autism understand and navigate daily routines and social situations.
Special Words	Special Words is designed to improve vocabulary, reading, and spelling skills in children with autism. It uses visual and auditory cues to teach new words and concepts, and it can be customized to suit individual learning needs.
Choiceworks	This app helps children with autism make choices and understand their daily routines through the use of visual schedules, timers, and social stories. It can be particularly helpful in reducing anxiety and improving transitions.
Sensory Baby Toddler Learning	This app focuses on sensory integration and provides a variety of interactive activities designed to engage the senses and promote sensory processing skills. It can be useful for children with autism who experience sensory sensitivities or seek sensory input.
From Learning Disability (LD)	
Endless Reader	This app focuses on teaching basic reading and spelling skills using interactive games and vibrant animations. It incorporates sight words and phonics to help children develop their reading abilities.
Mathseeds	Designed to improve math skills, this app offers engaging math activities and lessons. It covers various concepts such as counting, addition, subtraction, shapes, and more, using a visually appealing and interactive interface.
Metamorphabet	This app introduces children to letters and their corresponding sounds through interactive animations. Each letter transforms into different objects, helping children learn and recognize the alphabet in a fun and engaging way.
Visual Attention Therapy	Specifically designed for children with attention-related difficulties, this app includes games that target visual processing skills, attention span, and focus. It helps enhance visual attention and concentration abilities.

The availability of the above educational apps for disabled children promotes inclusive education. Smartphones as a tool to help improve the living standard of disabled children (Abid et al., 2013). They provide an opportunity for children with disabilities to learn and engage in educational activities alongside their peers, regardless of their physical or cognitive abilities. By making these apps widely available, we can ensure that no child is left in the learning. It's important to note that while educational apps can be valuable tools, they should not replace other forms of support and interventions. A holistic approach to education, including qualified teachers, inclusive classroom environments, and assistive technologies, should complement the use of educational apps to provide the best possible educational experience for ruler-disabled children in India.

3. Accessibility of Educational Apps for Children with Disabilities

Mobile applications (apps) play an essential role in the daily lives of billions of people throughout the world, ranging from personal banking to communication, transportation, education and other services. The ability to gain access to these essential services with ease is crucial for everyone, but notably for the 15% of the world's population who are disabled(*World Report on Disability*, 2011). Accessibility is defined as "The quality of being easily reached, entered, or used by people that have a disability" (Iwarsson & Hl, 2003). Making websites and apps more accessible to persons with disabilities while using smartphones and other mobile devices is referred to as mobile accessibility. Various mobile accessibility standards have been proposed, including W3C(Initiative (WAI), 2019). Web Content Accessibility Guidelines (WCAG 2.0 and 2.1) U.S. Revised Section 508 standard and BBC Standards and Guidelines for Mobile Accessibility from the UK Within these standards, several proposals have been made to improve support for people with disabilities such as motor, hearing, and vision impairment. Several firms have also developed their own set of developer rules based on standards, such as the Android Accessibility Developer rules. Apple's Developer Guidelines for Accessibility and IBM's Accessibility Checklist(Alshayban et al., 2020). Let's examine the accessibility of educational apps for children with disabilities. In this study, we focus on web content accessibility guidelines (WCAG).

3.1 Examining Accessibility of Educational Apps for Children with Disabilities

In educational contexts, accessibility for disabled students means that, for all to have equitable learning experiences, the learning experience, including its learning content and teaching process, should be adjusted according to student's needs, including their disabilities(X. Zhang et al., 2020). Examining educational apps for accessibility is an important task to ensure that students with diverse abilities can fully participate and benefit from the learning experience. When evaluating educational apps for accessibility, the web content accessibility guidelines (WCAG) 2.1 provide a comprehensive set of standards for web and app accessibility. Adhering to these guidelines is crucial for making educational apps accessible. WCAG 2.1 focuses on four main principles: Perceivable, Operable, Understandable, and Robust (POUR)(Ballantyne et al., 2018).

- **Perceivable (Text alternatives):** The perceivable principle ensures that material is recognisable by all users, even those who are impaired in one or more of their natural senses, such as blindness or deafness. Perceivable guidelines determine if content (e.g., audio or image) offers perceivable alternatives for people with disabilities(X. Zhang et al., 2020)
- **Operable (Keyboard Accessible):** The second concept, operability, refers to the idea that all functions should be completely usable by everyone, regardless of the user's restrictions. An application that does not allow for alternative control input, such as a keyboard, or one that imposes time constraints for actions is an example of a failure for the operable principle. Both of the preceding examples could make it difficult for a person with a motor handicap to use a mobile application(X. Zhang et al., 2020).
- **Understandable (Readable & predictable):** Understandability refers to the user's cognitive ability to comprehend the meaning of the supplied information. This category includes guidelines such as formatting elements to maintain predictable and consistent order, as well as giving contextual aid to guide users through actions(Acosta-Vargas et al., 2020).
- **Robust (Compatible):** The fourth and final concept, robustness, describes the adaptability of material concerning its interpretation by a variety of user agents, such as web browsers or assistive devices. Regardless of the fluidity and speed with which technology evolves, a robust application will ideally contain material that remains accessible in perpetuity no matter what changes occur. Assist in guiding users through actions(El-Glaly et al., 2018).

The realization of these principles and their respective sets of guidelines for the Web was a tremendous step forward for accessibility(Ballantyne et al., 2018). By implementing these principles, developers can ensure that their apps are usable and inclusive for children with a wide range of disabilities.

Here are some ways accessibility principles can fulfil the needs of disabled children in educational apps:

Table 2 Accessibility principles explained by purpose and benefits to children with disabilities

Category	Purpose	Benefit
Screen reader Compatibility	Audio can be controlled and accessed using apps. Apps offer written transcriptions or captions as alternatives to audio material(El-Glaly et al., 2018).	Allow people with hearing problems to see a textual transcription and description of audio-communicated content
Alternative text and captions	The text is formatted, sized, and coloured correctly. Non-text content is delivered via text alternatives like audio, Braille, or symbols(El-Glaly et al., 2018).	Allow individuals with vision problems to read, hear, feel, or otherwise perceive text-based material. Allow individuals with cognitive limitations to read and listen to content simultaneously
Keyboard accessibility	Gestures must have alternatives and can be replaced by other forms of interaction(El-Glaly et al., 2018).	Users with motor impairment can use simple gestures without fear of activating undesirable functions if they make a mistake.
Customizable setting	font size, colour themes, and text-to-speech functionality	app allows children to personalize their learning experience according to their specific needs
Colour contrast and visual clarity	The parts of the user interface, including images, are properly labelled, coloured, and positioned on the screen. Make it simple for users to navigate the app, find content, perceive it, and determine their location(El-Glaly et al., 2018).	Allow visually impaired children to navigate the UI and find controls and links. Allow screen reader users to use the app interface and navigate it
Clear navigation and organization	Well-structured navigation and organization menus, headings, and sections(El-Glaly et al., 2018).	Allow children with cognitive disabilities or attention disorders to locate and access educational content easily
Simplified instruction and feedback	Clear and concise instructions, along with immediate and informative feedback	Allow children with cognitive or learning disabilities to use simple language, visual cues, and step-by-step guidance can facilitate their comprehension and enable them to progress in their learning journey

Source: Ballantyne et al., 2018

By adhering to these accessibility principles, educational app developers can create an inclusive learning environment where disabled children can fully participate, engage with content, and reach their educational goals**.**

4. Opportunities for Educational Apps for Children with Disabilities

Ensuring access to inclusive and equitable education by 2030 will require us to rethink the means we use and accelerate the access to and affordability of digital technology(Ratheeswari, 2022). Educational apps give the opportunity. An interactive environment combined with the appropriate technology can radically transform the lives of individuals with special needs allowing them to explore the world and the opportunities it provides them(Zeenath Reza Khan et al., 2016). There are numerous opportunities for educational apps that cater to disabled children. These apps can be designed to support their unique learning needs and provide a more inclusive educational experience. Here are some potential opportunities for educational apps targeting disabled children:

- **Accessibility Features:** Develop apps with built-in accessibility features such as screen readers, voice commands, larger text sizes, and high contrast options. These features can make the app more accessible for visually impaired or blind children(*Assistive Technology for Children with Disabilities*, 2015).
- **Individualized Learning:** Create apps that offer personalized learning experiences, adapting to the specific abilities and needs of each child. This cloud includes customizable settings, adaptive content and tailored learning paths(Karpenko et al., 2019).
- **Communication Support:** Design apps that facilitate communication for children with speech and language disabilities. These apps can include augmentative and alternative communication (AAC) tools, such as symbol-based or text-to-speech systems(Obisat & Hattab, 2009).
- **Motor Skill Development:** Develop apps that promote the development of fine motor skills or assistive technology apps for children with physical disabilities. This app can include activities that improve hand-eye coordination or offer adaptive controls for children with limited mobility(Zeenath Reza Khan et al., 2016).
- **Social skill training:** Create apps that focus on social skill development and social interaction for children with autism spectrum disorders or other social communication difficulties. This app can provide scenarios, interactive games and social stories to help children learn and practice social skills in a safe and engaging environment(Günindi, 2014).
- **Sensory Integration:** Design apps that address sensory integration challenges experienced by children with sensory processing disorders. This app can offer calming activities, sensory stimulation exercises, or interactive games that promote sensory integration.
- **Emotional well-being:** Develop apps that promote emotional well-being and mental health support for disabled children. This app can provide mindfulness exercises, relaxation techniques or coping strategies to help children manage stress and emotions(Gindidis & Larsen, 2021).
- **Collaboration and inclusion:** Create apps that encourage collaboration and inclusion among disabled and non-disabled children. These apps can facilitate joint activities, cooperative games, or virtual classrooms where children interact and learn together.
- **Parent and Teacher Support:** Develop an app that provides resources, guidance, and progress tracking for parents and teachers working with disabled children. This app can include lesson plans, behaviour management strategies, and communication tools to foster collaboration between parents' teachers, and therapists(Setyawan et al., 2016)
- **Gamified Learning:** Design learning apps that incorporate gamified elements to make learning more engaging and motivating for disabled children. This app can include rewards, achievements, and interactive challenges to encourage active participation and long-term engagement(Welbers et al., 2019).

It's important to involve educators, therapists, and parents in the development process to ensure that the apps effectively address the specific needs of disabled children and align with educational goals. Additionally, considering the diverse range of disabilities, it's crucial to make the apps customizable and adaptable to individual requirements.

5. Challenges of Educational Apps Used by Children with Disabilities

Mobile applications have made amazing progress in the sphere of education; the situation is encouraging, and prospects are usually positive. However, the educational Apps market is still in its early stages of development, with a large number of "zombie applications," a lack of good works, and a low level of innovation. Willingness to pay, quality, and other difficulties must be addressed. Investigate its cause: educational apps' approach to the development problem is unbalanced, the quality is poor, and the business model is unclear, among other things. Here are some common challenges associated with educational apps for children with disabilities.

- **The development of the Apps education is not balanced:** Three parts of educational app development are out of balance. First, children's educational apps are popular, however, educational apps for children with disabilities are underdeveloped(Meyer et al., 2021). Second, while English educational apps have been established, other subject categories of educational apps are still in the works. Language educational Apps are a current development trend in terms of subject categories. English instructional Apps have a high demand among students and other groups, resulting in a big market share. There is no shortage of fantastic mobile Apps for the user to choose from in terms of words, listening, reading, and other elements(J. Zhang & Liao, 2015). Third, educational apps frequently indicate informal learning that is inconsistent with classroom instruction. Currently, the content of educational Apps is frequently fragmented and isolated and has not developed a system that is on the cutting edge of classroom teaching. The learning material decides whether educational Apps are formal or informal. Learning, it is impossible to construct a comprehensive set of teaching in the classroom, which limits the depth and breadth of educational App development to some extent(J. Zhang & Liao, 2015).

- **Lack of attention and emotional development using educational apps:**

Daniel Goleman, Ph.D., of Emotional Intelligence fame, is concerned that the use of technology (Apps) is impairing children's capacity to focus and may have an impact on emotional development. "The circuitry for paying attention and the circuitry for managing distressing emotion are identical," Goleman explains. He claims that if children do not learn to pay attention in school, they will not develop the essential self-control and empathy for others. He also mentions that the capacity to pay attention is a strong indicator of future success(*Are Learning Apps Helping or Hurting Education?*, n.d.). Most studies discovered that so-called "educational apps" are frequently designed to entertain children with sounds, images, and effects, resulting in distraction rather than instruction; additionally, these apps generally provide children with too many options, resulting in distraction and lack of engagement. Importantly, even when meant to be engaging, these apps lack actual educational content(Cerniglia & Cimino, 2020).

- **Security issues in the use of educational apps:**

As a result, as more individuals use smartphones and tablets for educational and financial purposes, attackers with malicious intent will find these devices and their applications more appealing. As a result, According to security surveys, the number of mobile threats is rapidly increasing, as is the sophistication of the attacks(Sampat & Prabhakar, 2017). According to the international non-governmental organization's research of the applications, as many as 146, or 89%, of the 164 apps and websites engaged in some conduct that jeopardised the safety, privacy, and confidentiality of children using these platforms for education(Aryan, 2022). The current technological breakthroughs and unparalleled proliferation of mobile educational apps have instilled a great deal of confidence in its users; nevertheless, they are unaware that mobile devices can be hacked, misplaced, or stolen. As a result, one's personal information and professional data may get into the hands of an intruder or a third party (Mkpojiogu et al., 2021).

- **The quality of educational Apps needs to be promoted:**

Quality is the product's life cycle, and educational apps are no exception. Many mobile education apps have a low degree of development, rough production, a lack of user viewpoint, and homogenization of serious, old information. As a result, people are unwilling to pay for educational apps. How can the quality of educational apps be improved? According to the research, educational Apps must have rich material, based on the concept of

scientific nature, and make proper use of multimedia to establish the user's perspective and ensure the level of educational Apps(J. Zhang & Liao, 2015).

6. Discussion and Conclusion

This article looks into the availability, accessibility, and restrictions of educational apps designed for children with disabilities. Our goal is to use educational applications as a key instrument for improving the educational environment for impaired children. Contemporary students with disabilities are more inclined towards flexible learning, which is facilitated by rapid access to educational apps at any time and from any location. We are witnessing a revolutionary moment in mobile learning, driven by the growing use of educational apps. The use of educational apps is becoming increasingly sophisticated as mobile terminal technology and wireless networks continue to advance. As a result, the understanding and use of educational apps among students with disabilities is steadily expanding, while an increasing number of businesses and individuals are avidly participating in educational app development efforts. This growing interest highlights the significant growth potential of educational apps, yet it also brings to light the persistent challenges that need to be addressed in this dynamic digital landscape. However, amidst this rapid growth, persistent challenges emerge, demanding attention. These challenges encompass issues of inclusivity, usability, and equitable access, which necessitate ongoing discussion and proactive solutions to ensure that the benefits of educational apps are maximized for all children with disabilities.

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