

# SpecialMinds: Learning App for Visually Impaired Students

Ritika Lala<sup>1,\*</sup>, Sania Khan<sup>2</sup>, Samia Kazi<sup>2</sup>

## Abstract

*This research aims to identify the challenges and barriers that visually impaired students encounter in the educational environment, with a focus on adaptive strategies and innovative solutions. Visually impaired students often experience difficulties in listening, speaking, reading, writing, conceptual understanding, and social communication. As one of the most excluded and discriminated groups in society, these students may feel isolated, which further impacts their learning. Given the significance of quality education in today's knowledge-driven world, it is essential to address these challenges. The current educational curriculum, largely dependent on vision, poses particular difficulties for visually impaired students. This investigation explores the impact of visual impairment on learning, identifies adaptive teaching methods, and examines the role of technology, materials, and human assistance in helping visually impaired students succeed. The analysis aims to propose innovative strategies to enhance learning outcomes and integration for visually impaired students in mainstream educational environments.*

**Keywords:** Learning App, disabled students, visually impaired, quiz for blind, study resource, online app

## INTRODUCTION

In today's rapidly evolving educational landscape, the need for inclusive education, particularly for visually impaired students, has never been more pressing. Globally, an estimated 253 million people live with visual impairments, and 36 million of them are completely blind. Among these, approximately 8 million individuals in India face vision impairment, with around 3 million students dealing with significant challenges in accessing quality education. These students encounter various barriers, including limited access to Braille materials, a shortage of trained educators, and a lack of assistive learning technologies specifically designed for their needs [1].

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## Bridging the Gap with a Cutting-Edge Learning Application

To address this critical issue, we are developing a state-of-the-art learning application tailored to the educational needs of visually impaired students [2]. This app is designed to be user-friendly and intuitive, leveraging cutting-edge technologies to make education more accessible. Key features include:

1. *Easy Navigation:* The app utilizes gesture controls and voice commands to facilitate seamless interaction for users with visual impairments.

2. *TalkBack Integration*: The app utilizes TalkBack, a screen reader that reads out text, buttons, and other interface elements, allowing visually impaired students to navigate through the app seamlessly. This feature ensures that users can access educational content, instructions, and interactive elements through spoken feedback, promoting a more inclusive learning experience [3].
3. *Speech Recognition*: This feature allows users to issue voice commands, answer questions, and navigate the app without the need for sighted assistance.

By incorporating these advanced features, the app aims to level the playing field for visually impaired students, providing them with the same quality of education that is available to their sighted peers. Through the use of accessible technologies, the app fosters independence and encourages visually impaired students to engage more deeply with learning materials, especially in subjects like mathematics, science, and English [4].

### THE EDUCATION SYSTEM FOR VISUALLY IMPAIRED STUDENTS IN INDIA

India's educational framework for visually impaired students is governed by several legislative initiatives that aim to promote inclusive education. Key policies include:

1. *Right to Education (RTE) Act, 2009*: This legislation mandates that every child has the right to free and compulsory education, emphasizing inclusive education for children with disabilities.
2. *Rights of Persons with Disabilities (RPwD) Act, 2016*: This act strengthens the legal framework to support the inclusion of students with disabilities in mainstream schools and universities.

#### Visually impaired students in India have two primary options for education:

1. *Special Schools*: These institutions cater specifically to visually impaired students, using Braille, tactile learning methods, and audio-based instruction to meet their needs.
2. *Inclusive Schools*: Mainstream schools that aim to include visually impaired students by offering resources such as Braille textbooks, audiobooks, and assistive technologies.

However, the education system still faces several significant challenges, particularly concerning the accessibility and quality of educational resources [5]. While government initiatives and non-governmental organizations (NGOs) like the National Association for the Blind (NAB) and Xavier's Resource Centre for the Visually Challenged (XRCVC) provide support, gaps remain in infrastructure, teacher training, and the availability of accessible learning materials. Many schools lack tactile pathways, accessible washrooms, and properly trained special educators, especially in rural areas. Additionally, the high cost of Braille and large print textbooks, especially in higher education, further limits access [6].

#### Overcoming the Challenges

To create a truly inclusive and equitable education system for visually impaired students in India, several critical areas must be addressed:

1. *Enhanced Teacher Training*: More educators need to be trained in teaching visually impaired students, using both traditional and modern assistive technologies [7].
2. *Increased Access to Learning Materials*: The production and distribution of accessible materials, such as Braille and large print textbooks, need to be expanded, particularly for specialized subjects.
3. *Subsidizing Assistive Technologies*: The high cost of assistive technologies often limits their availability, particularly in rural areas. Government subsidies and initiatives to make these technologies more affordable would significantly improve access [8].
4. *Flexible Examination Formats*: Visually impaired students face additional challenges during examinations, with limited availability of scribes, audio question papers, and other necessary accommodations. A more flexible examination system that caters to their needs is essential for ensuring equal opportunities [9].

## **THE ROLE OF TECHNOLOGY IN IMPROVING ACCESSIBILITY**

A critical component of enhancing education for visually impaired students lies in the conversion of visual information into formats that utilize other senses, such as touch and sound. Innovations in tactile and auditory media, Braille cards, and specialized applications offer alternative ways to deliver educational content. Technology, particularly in the form of mobile applications, has the potential to revolutionize education for visually impaired students by offering interactive and customized learning experiences.

For instance, converting text to speech is now more feasible, and advancements in smartphone technology have made it easier for visually impaired individuals to access digital content. As of the latest data, India has over 1.1 billion mobile phone users, and smartphones constitute a growing share of this market. With this widespread mobile penetration, smartphones provide a versatile platform for educational applications [10].

### **The Power of Smartphones and Mobile Applications**

Smartphones have become indispensable tools for visually impaired individuals, thanks to advancements in accessibility features. Platforms like Android, known for their flexibility and wide adoption, present an ideal foundation for building educational applications tailored to the needs of visually impaired students. Previous research has already explored the use of audio-based teaching materials stored on flash drives, but the potential of smartphones takes this concept further by offering real-time, interactive learning experiences.

In this context, our Android-based learning application is designed to empower visually impaired students by offering practice questions and learning materials in core subjects like mathematics, science, and English. The app is intended not only to facilitate independent learning but also to enhance engagement and retention through the use of intuitive, accessible interfaces. By leveraging gesture controls, TTS, and speech recognition, the app offers a more personalized learning experience that accommodates the unique needs of visually impaired learners.

## **LITERATURE REVIEW**

The use of mobile technology to support education for visually impaired students has gained significant attention in recent years, with advancements in accessibility features making smartphones and tablets more user-friendly for this population [11, 12]. Among the various mobile operating systems, Android is particularly favoured for developing educational applications due to its widespread availability, open-source nature, and extensive customization options [13]. These characteristics make Android an ideal platform for creating learning applications tailored to the needs of visually impaired students.

Previous research has explored different technological solutions to enhance learning experiences for visually impaired students across various subjects. For instance, Arlinwibowo and Retnawati developed audio-based teaching materials for mathematics stored on flash drives, which provided a foundation for further innovation in digital learning tools [14]. However, with the rapid advancement of technology, there is now potential to develop more interactive and user-friendly applications on mobile platforms, such as Android, that can provide practice questions and learning activities for subjects like mathematics, science, and English. The integration of auditory and tactile learning aids into these apps can facilitate better comprehension and engagement for visually impaired students by leveraging their remaining senses [15, 16].

Studies have also highlighted the importance of accessibility and usability in designing educational tools for visually impaired students. Research by Igrisa *et al.* demonstrated how converting visual information into non-visual formats, such as Braille, tactile graphics, or audio descriptions, significantly enhances accessibility for visually impaired learners [17]. Additionally, technological solutions like

text-to-speech (TTS) and voice recognition have been shown to improve the usability of mobile applications for visually impaired users, making learning more accessible and interactive.

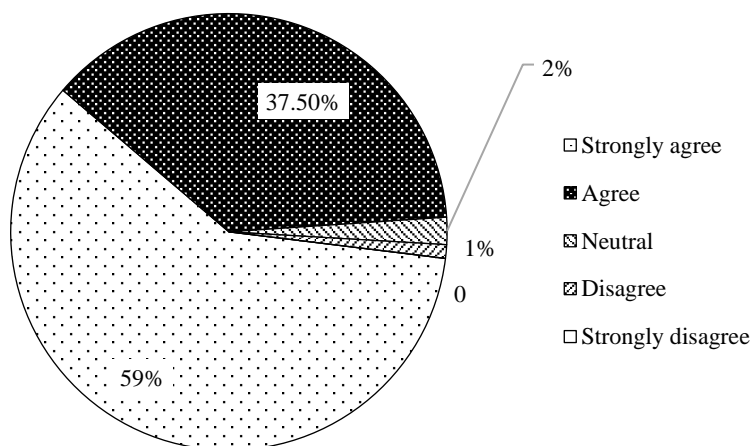
Despite these advancements, there are still significant challenges in providing visually impaired students with equitable educational opportunities. The cost of developing and distributing accessible educational materials, such as Braille books and tactile learning aids, remains high. Moreover, many existing learning materials are not yet fully accessible, which limits their effectiveness for visually impaired students. As such, there is a pressing need for innovative solutions that leverage mobile technology to create affordable, accessible, and effective learning tools for this population.

In light of these considerations, the development of an Android-based learning app specifically designed for visually impaired students represents a promising avenue for research and development. Such an app could provide visually impaired students with greater independence and flexibility in their learning by offering practice questions and interactive learning activities in accessible formats. This study aims to contribute to this field by developing an Android-based application that facilitates learning in mathematics, science, and English for visually impaired students, ultimately promoting greater inclusivity and accessibility in education.

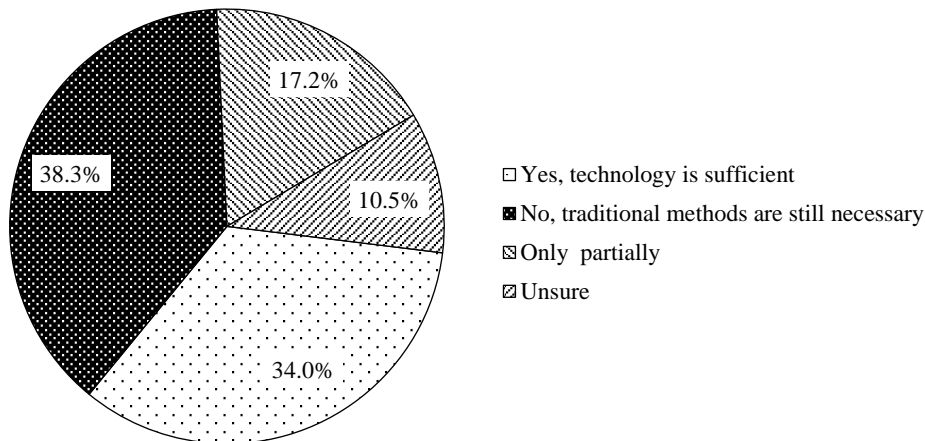
### SURVEY ANALYSIS

The development process began with a survey study that gathered 256 responses from participants across various age groups, including "Under 18", "18–24", "25–34", "35–44", and "45–54". The survey aimed to identify the key competencies that visually impaired students need to achieve in each subject. The responses revealed that a significant portion of participants had never used an app specifically designed for blind or visually impaired users, highlighting the urgent need for such solutions. Despite this lack of exposure, the majority of respondents expressed strong support for using technology to enhance education for visually impaired students. The feedback showed a clear consensus on the importance of schools and educational institutions investing in technology for inclusivity, as shown in Figure 1.

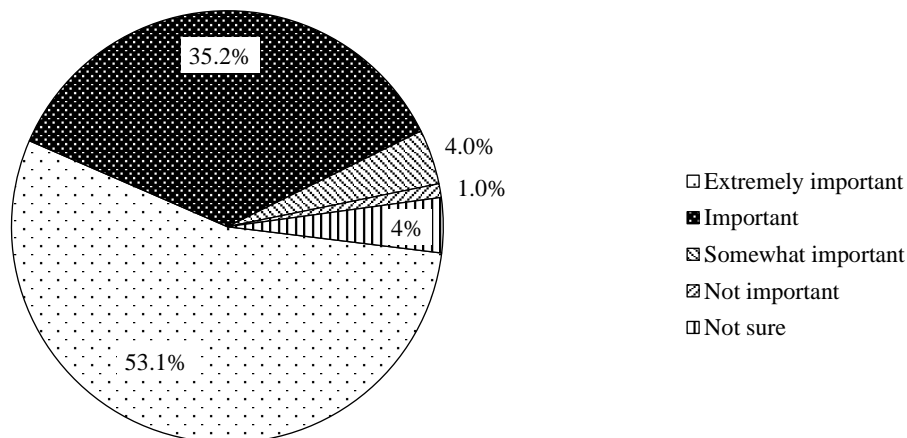
The surveys assess the role of technology in educating visually impaired and blind students. The first survey shows strong support for increasing investment in technology, with the majority agreeing on its importance. The second survey shown in the Figure 2, however, reveals divided views on whether technology can fully replace traditional learning methods for blind students, with many favouring a balance. Overall, the surveys suggest that while technology is crucial, traditional methods still hold value in supporting these students. The motive is to inform decisions on integrating technology with traditional approaches in education.



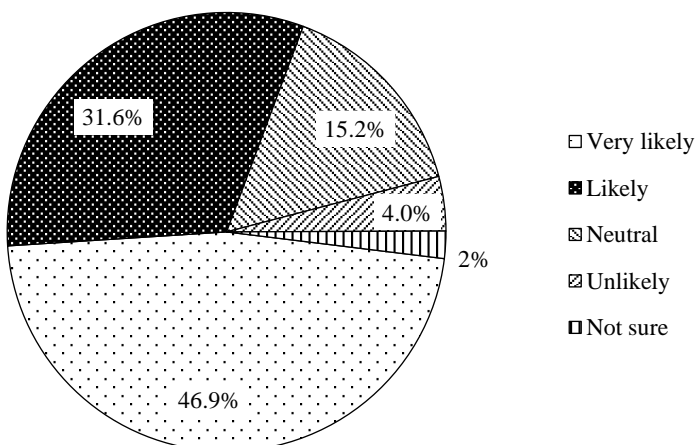
**Figure 1.** Ratio of schools and educational institutions should invest in technology for visually impaired students.



**Figure 2.** Ratio of believe that technological advancements can fully replace traditional learning for blind students.

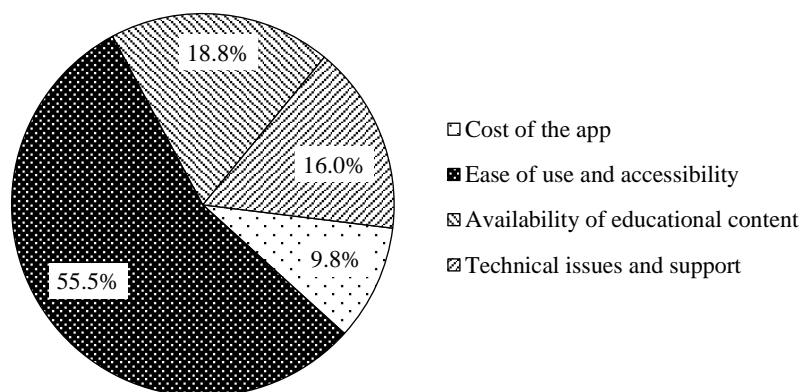


**Figure 3.** Ratio of government funding for developing educational technology for blind student.

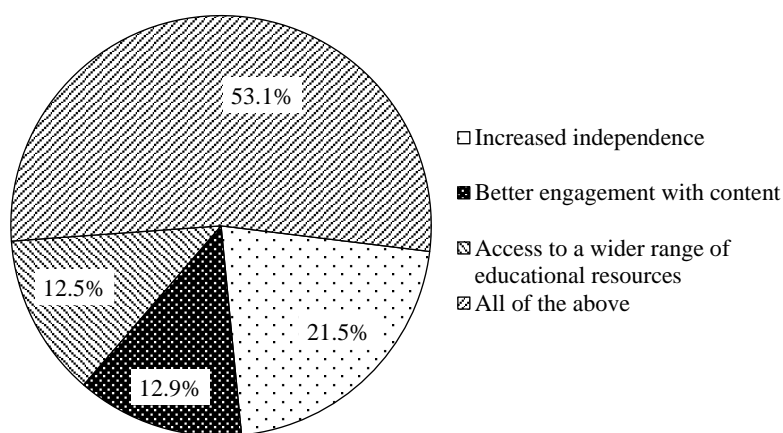


**Figure 4.** Recommendation of an online learning app for blind students to other.

The survey shows that a majority of respondents (53.1%), as shown in the Figure 3, believe government funding is extremely important for developing educational technology for blind students, with 35.2% agreeing it is important. Additionally, when asked about recommending an online learning app for visually impaired students, most respondents were "very likely" or "likely" to do so, reflecting a positive attitude toward these technological solutions as shown in Figure 4.



**Figure 5.** Primary concern about using online learning apps for blind student.



**Figure 6.** Ratio of believe is the greatest benefits of using technology in education for blind students.

The primary concern regarding online learning apps for blind students is ease of use and accessibility (55.5%), followed by availability of educational content (18.8%), technical issues and support (16%), and cost (9.8%), shown in Figure 5. On the other hand, when asked about the greatest benefit of using technology in education for blind students, shown in Figure 6, the majority (53.1%) believe that all of the above factors increased independence, better engagement with content, and access to a wider range of resources are significant, while 21.5% specifically value increased independence.

### METHODOLOGY

The product was developed following a thorough preliminary analysis, incorporating data from Google form survey that gathered 256 responses. One of the key challenges for visually impaired students is achieving independent learning. Many learning materials are heavily reliant on visual illustrations and are often inaccessible to students with visual impairments. Additionally, the lack of adequately tailored learning facilities further hinders their ability to study effectively. Given the widespread use and capabilities of smartphones, particularly Android devices, which offer numerous built-in assistive features like voice commands, screen readers, and vibratory feedback, we recognized the potential to leverage this technology to develop a solution that caters to the unique needs of visually impaired students.

This study focuses on creating an Android-based learning application designed specifically to provide accessible content for visually impaired students in core subjects such as Mathematics, Science, and English. The application aims to overcome the challenges posed by traditional learning resources by offering audio-based content and ensuring ease of use with simple navigation. The primary mode of interaction with the app is through audio and touch, allowing students to easily navigate through lessons

using the TalkBack screen reader, which provides spoken feedback as they interact with various elements. The application also includes a Braille feature for learning basic alphabets and numbers, ensuring a comprehensive and inclusive learning experience.

The built-in hardware of Android devices, including touchscreens, microphones, and vibration motors, plays a critical role in the app's functionality. These features are used to create a highly interactive learning environment where students can engage with study materials, practice questions, and take tests independently. Research supports the use of technology as a powerful tool for visually impaired students, particularly in subjects like Mathematics, which can often be difficult to teach using traditional methods. The same principles are applied to Science and English, ensuring that each subject is presented in a way that is both comprehensive and accessible.

Additionally, the app provides detailed audio study notes for subjects like Maths, Science, English which can be accessed by students at their own pace. This enables them to review and understand complex concepts independently, which is especially valuable in preparing for exams or completing assignments. The user interface is designed with simplicity in mind, ensuring that visually impaired students can navigate the app easily, without needing constant guidance. Large buttons, clear voice prompts, and vibration cues help create a seamless experience that encourages continuous engagement.

The final product includes several features that set it apart from other educational apps. In addition to offering audio-based lessons in Mathematics, Science, and English, the app also includes a test module that evaluates student performance in each subject. The tests are conducted using the Talkback feature. This feature, along with simple gestures, ensures that the test process remains intuitive and easy to navigate, providing a smooth and accessible experience for students.

At the end of the test, results are announced in audio format, allowing students to receive immediate feedback. Moreover, the app includes a history page, where students can review their test results from previous sessions. This feature is designed to help students track their progress over time, empowering them to take ownership of their learning journey. By combining user-friendly design, advanced assistive features, and comprehensive content, the app represents a significant step toward creating a more inclusive educational environment for visually impaired students. With future updates and continued feedback from users, the app aims to set a new standard in accessible education technology.

## SYSTEM STRUCTURE

The app is built using Android Studio Koala version with APK 19, ensuring compatibility with devices running Android OS. It uses Java as the programming language for logic and XML for interface design and styling. The application integrates the TalkBack screen reader, allowing visually impaired users to receive audio feedback and navigate the app through spoken guidance.

### Key Modules and Functionalities

1. *Blind Learning Application:* This functionality helps visually impaired users learn and recognize numbers, shapes, and alphabets through vibratory feedback. The app covers various topics to aid learning through interactive gestures.
2. *Display Module:* This module governs the size and placement of icons and buttons, ensuring that visually impaired users can easily interact with the interface, even though they do not rely on the visual display itself.
3. *XML for Styling:* XML is used to style and define the dimensions of interface elements like buttons and icons, ensuring consistency in design and usability for tactile interactions.
4. *Java for Runtime Interaction:* The Java code handles dynamic content changes, such as navigating between screens or processing user commands. Intents are used to facilitate smooth transitions between different activities.

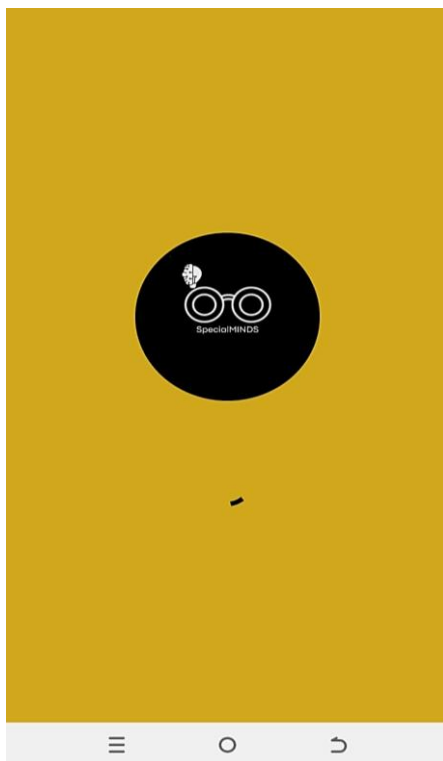
5. *TalkBack*: The application integrates the TalkBack feature, enabling visually impaired users to navigate the app through spoken feedback. This ensures seamless interaction with the app's content using audio guidance and touch gestures.
6. *On Screen Listener*: This component tracks user interactions on the screen, such as touch events, capturing gestures like taps or swipes. Motion events are used to record these actions, allowing for appropriate feedback.
7. *Speech on Click*: This feature provides speech feedback when a button is clicked. The event listener detects button taps and executes the corresponding action, providing an auditory response.

### Implementation Details

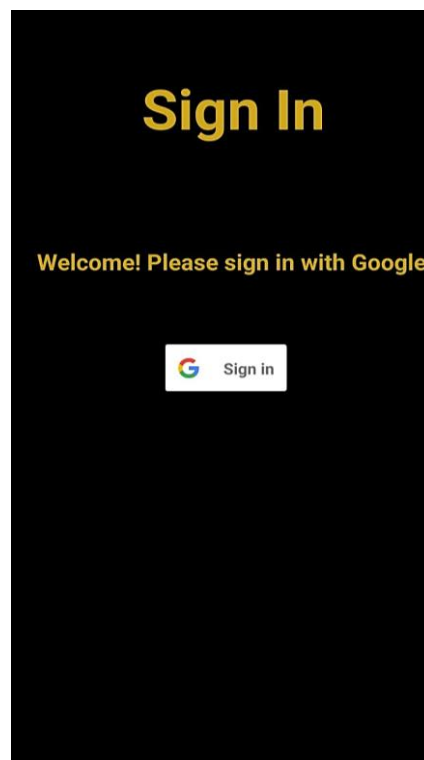
The implementation of our Android app named as **SpecialMinds** for visually impaired students involves several key phases that enhance accessibility and ease of use through voice recognition and audio-based interactions.

The splash screen appears when the app is loading. This screen serves as the initial interface and introduces the app's branding and purpose as shown in Figure 7. During this phase, the app prepares the user interface and necessary data for seamless navigation and interaction.

The first phase is the login process, where the user, i.e., the visually impaired student, is provided with the option to sign in directly using their Google account as shown in the Figure 8. This eliminates the need for manual input of information like name and phone number. The Google sign-in process, supported by speech recognition technology, allows the user to navigate and authenticate with voice commands as shown in Figure 9. Once logged in, the system confirms the successful login with voice feedback, ensuring a smooth and accessible experience without requiring any visual input. The user is directed to the home page after logging process as shown in Figure 10, which features large, easily accessible buttons for navigation. Using TalkBack features the user selects the subject they wish to study, and based on their response, the corresponding subject module opens.



**Figure 7.** Opens Splash Screen.



**Figure 8.** Shows the Sign in method using Google.

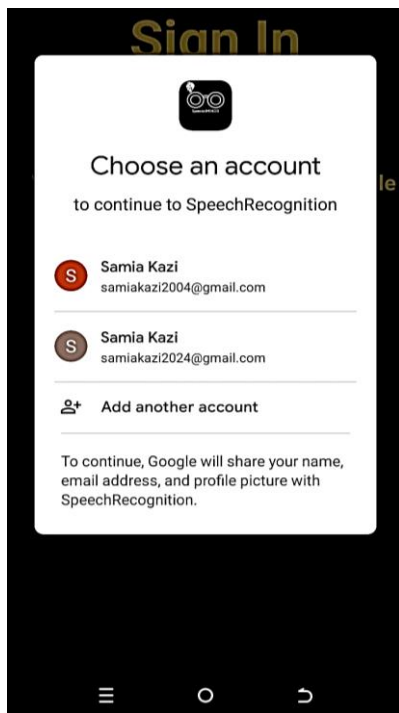


Figure 9. Choose an Account to Sign in page.

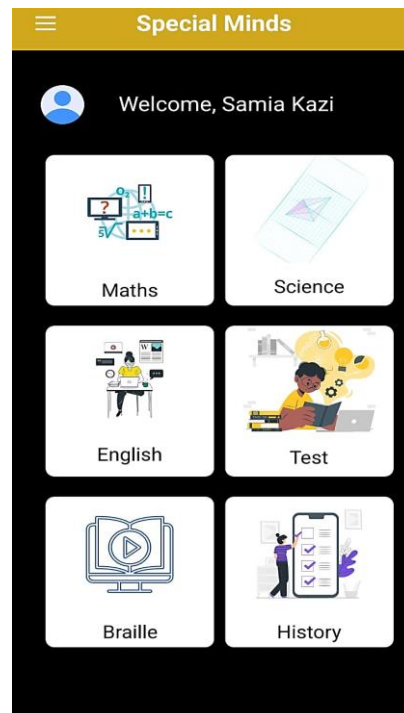


Figure 10. Shows the Home.

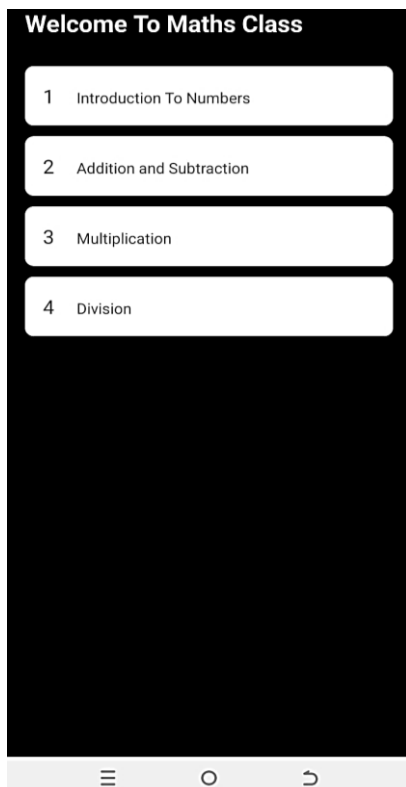


Figure 11. Shows the Maths Subject consisting of audio Based chapters.

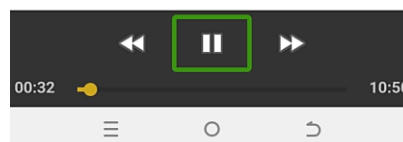
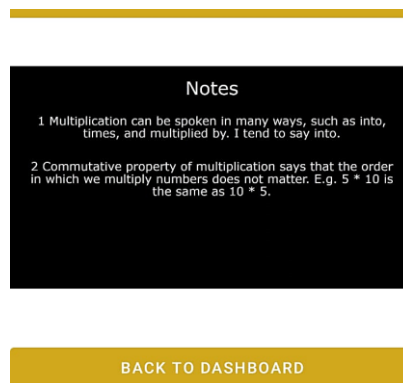


Figure 12. Shows the Content (Video) of Chapter.

Each subject module contains audio-recorded chapters, as shown in Figure 11, that students can listen to, making learning fully auditory and accessible. The content of the chapters, depicted in Figure 12, is easy to navigate through simple gestures, ensuring a seamless experience for visually impaired students.

In the evaluation phase, the app includes a test module for each subject, as demonstrated in Figure 13. The tests are conducted using the Talkback feature, illustrated in Figure 14.

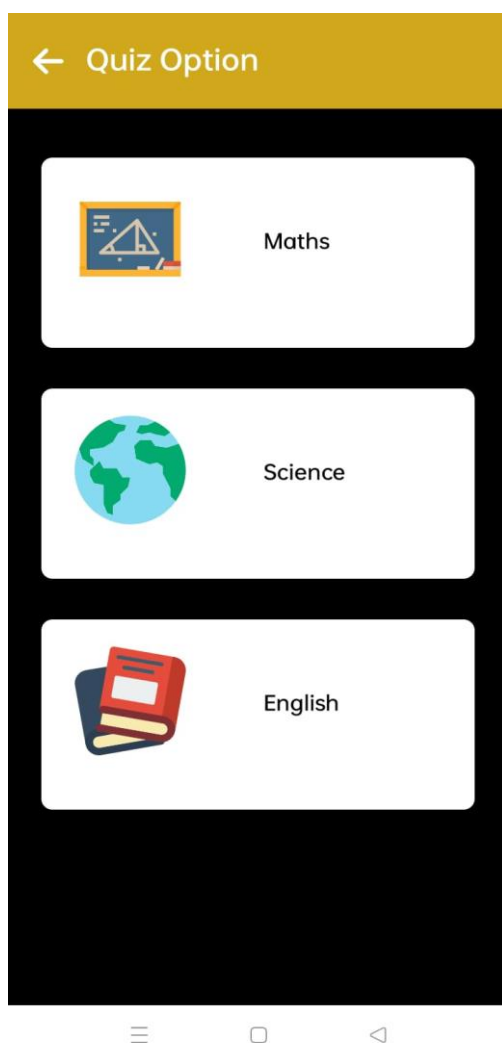
This feature, along with simple gestures, ensures that the test process remains intuitive and easy to navigate, providing a smooth and accessible experience for students.

At the conclusion of the test, the app announces the result shown in Figure 15 which is automatically saved in Result history.

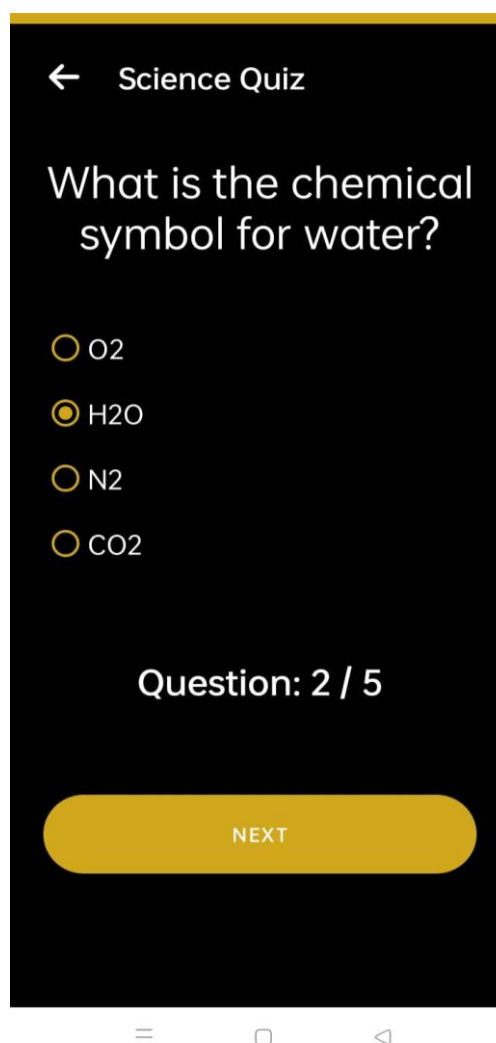
In addition, the app includes Braille support as shown in Figure 16 for basic learning of math and alphabets, providing an additional layer of support alongside the auditory content.

An example of English characters in Braille is provided in Figure 17, further enhancing the learning experience for visually impaired students. Additionally, the app features a history page shown in Figure 18, where all previous test results are stored and presented in audio format.

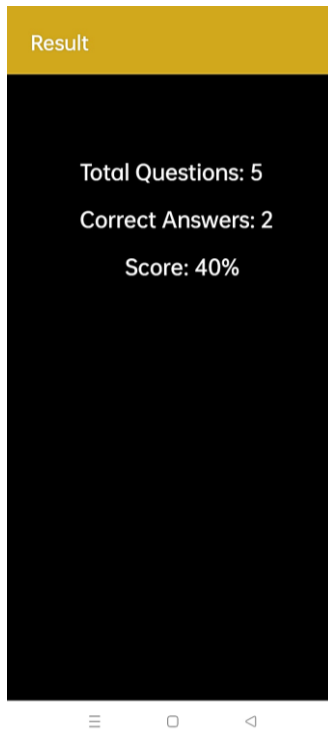
This allows students to easily track their progress over time without any visual assistance. The combination of Talkback, large buttons, Braille support and audio feedback ensures that visually impaired students can engage with the app independently and effectively.



**Figure 13.** Shows the Test.



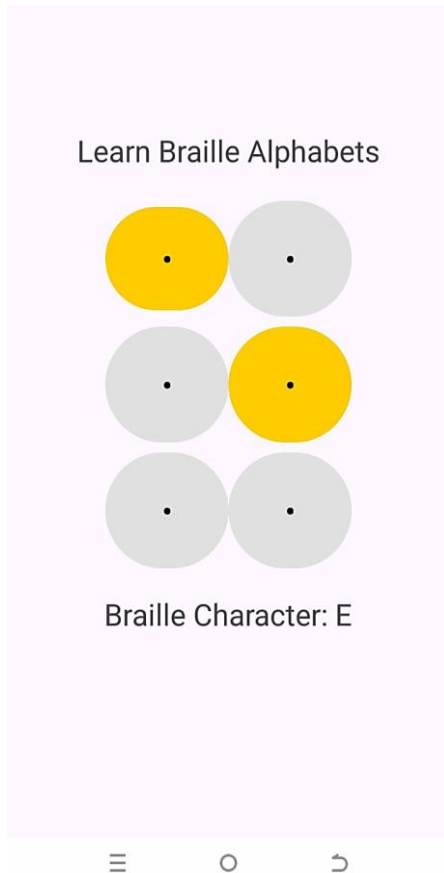
**Figure 14.** Shows Science Test.



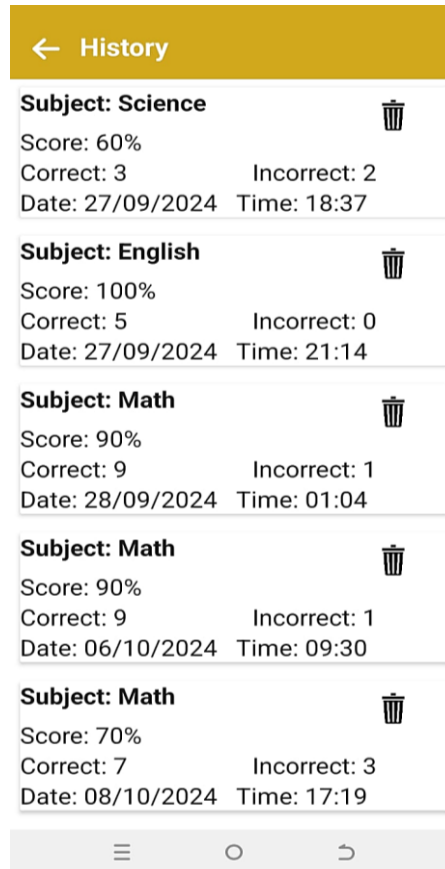
**Figure 15.** Shows the Result generated.



**Figure 16.** Shows Braille Subject.



**Figure 17.** Shows Braille Alphabets



**Figure 18.** Shows Result History

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## Future Scope

The future scope of the Android-based learning app for visually impaired students holds immense potential, offering numerous avenues for innovation and improvement. With education moving further into the digital realm, there is a growing opportunity to refine and expand the app to meet the diverse needs of visually impaired learners. By integrating cutting-edge technologies and enhancing accessibility features, the app could transform the educational experience for students with visual impairments, helping them achieve greater independence and success.

1. *AI and Machine Learning Integration:* AI can provide personalized learning experiences, adjusting content based on student performance, offering real-time feedback, and optimizing the learning process for each student.
2. *Expanding Multilingual Support:* Adding support for multiple regional languages will broaden accessibility, enabling students to learn in their native language and improving engagement.
3. *Expanding Subject Coverage:* The app could include additional subjects like social studies, arts, vocational training, and life skills, offering a more holistic educational experience.
4. *Braille Support:* Integrating Braille compatibility with devices like refreshable Braille displays will make the app more inclusive for tactile learners, especially during exams or complex lessons.
5. *Collaboration with Educational Institutions and NGOs:* Working with schools, government bodies, and NGOs will help ensure the app meets curriculum standards and continues to address the needs of visually impaired students through regular updates and feedback.

## CONCLUSION

In conclusion, the development of an Android-based learning app for visually impaired students offers a transformative opportunity to address the significant barriers that these students face in accessing quality education. By incorporating features such as voice recognition, audio-based content, easy navigation, and tactile feedback, this app aims to create an inclusive and user-friendly platform that enhances learning across core subjects like mathematics, science, and English. The integration of test modules and audio-based assessments further supports student evaluation, allowing for independent learning and performance tracking.

As technology advances, the app's potential for future growth is immense. Enhancements such as multilingual support and Braille integration could broaden its impact, making it even more accessible to students across different regions and learning environments. Collaboration with educational institutions and ongoing user feedback will be crucial in refining and expanding the app's features, ensuring it remains a valuable tool for visually impaired learners.

Overall, this app has the potential to bridge the digital divide in education for visually impaired students, providing them with the tools and resources needed to thrive academically. By leveraging the power of technology, we can move towards a more equitable and inclusive education system, where every student, regardless of their visual ability, has the opportunity to succeed.

The educational challenges faced by visually impaired students are multifaceted, spanning a lack of accessible materials, insufficient infrastructure, and the high cost of assistive technologies. However, with the development of innovative solutions like mobile applications, there is immense potential to bridge these gaps and make education more inclusive. Our cutting-edge learning app, designed specifically for visually impaired students, represents a step forward in this direction, providing a platform that empowers these students to learn independently, access core educational content, and engage with technology on par with their sighted peers.

India's education system, supported by legislative frameworks and advocacy from organizations, is gradually moving towards inclusivity, but there is still much work to be done. By investing in teacher training, expanding access to accessible learning materials, subsidizing assistive technologies, and adopting more flexible examination systems, India can create a more equitable and inclusive

educational environment for its visually impaired students. As technology continues to advance, the potential for truly accessible education grows, and solutions like our app will play a crucial role in achieving this vision.

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