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ADAPTIVE INTERACTIVE FEATURES IN THE *'LISTEN TO ME'* APPLICATION TO SUPPORT INDEPENDENT LEARNING FOR VISUALLY IMPAIRED CHILDREN

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Abstract

Advancements in information and communication technology have created new opportunities for developing accessible and adaptive learning systems. One promising approach is the use of audio-based learning applications, which substitute visual information with structured auditory instructions. This research aims to develop adaptive interactive features in the 'Listen to Me" *application to enhance the independent learning skills of visually impaired children. The features are designed with three main characteristics: automatic adaptation of material difficulty levels; an audio-based interface that delivers clear instructions and feedback; and dynamic responses that adjust to users' interaction patterns. The study employed a Research and Development (R&D) approach with a waterfall model, executed through the stages of needs analysis, design, implementation, testing, and evaluation. Expert evaluations of the developed features indicated a very high level of feasibility. Furthermore, the results of limited trials involving the target users (visually impaired children) demonstrated the features' effectiveness in improving content comprehension, facilitating navigation, and fostering motivation for independent learning. The findings conclude that the adaptive interactive features within the* Listen to Me *application are feasible, effective, and accessible as a self-learning medium, offering strong potential to support the expansion of inclusive education for visually impaired children.*

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INTRODUCTION

Independent learning has become a central educational goal in the 21st century because it enables students to regulate their own learning, identify appropriate resources, solve problems with increasing autonomy, and develop confidence in reaching academic targets (Meilany et al., 2025). This competency is particularly important in contemporary learning environments

where students are expected not only to receive information, but also to manage, interpret, and apply knowledge independently. For children with visual impairments, however, the development of independent learning remains constrained by unequal access to appropriate learning resources. Much of today's educational content is still designed primarily for sighted learners and presented through visual interfaces, diagrams, text displays, and image-based instructions that are difficult or impossible to access without support (Aftab & Ghaffar, 2025). As a result, visually impaired learners frequently encounter barriers that limit their participation in classroom activities and reduce opportunities to practice self-directed learning. Inaccessible learning environments can create unequal learning experiences and reinforce reliance on teachers, parents, or peers, rather than cultivating autonomy as a long-term learning capacity (Banovic, 2013). This condition highlights the need for more inclusive learning media that are intentionally designed around the sensory characteristics and learning needs of visually impaired children (Egilson, 2009).

The challenge is not merely technical, but also educational and social. Independent learning for visually impaired children is closely tied to questions of equity, participation, and educational inclusion. When students are unable to access instructions, feedback, or content without continuous assistance, they are placed in a dependent position that can affect motivation, confidence, and agency in learning. UNESCO (2020) emphasizes that learners with stronger autonomy are better able to participate meaningfully in academic and social environments. This means that accessibility should not be understood only as the ability to hear or receive content, but also as the ability to navigate learning tasks, make decisions, monitor progress, and respond to challenges with reduced dependence on others. Therefore, the issue facing visually impaired learners is not simply the absence of accessible media, but the absence of learning systems that actively support independence through structured guidance, meaningful interaction, and progressive skill development (Salwa, 2025; Daulay et al., 2022).

Recent developments in information and communication technology have opened important opportunities for creating more accessible and adaptive learning systems for students with disabilities (Hakobyan, 2024). Among the most relevant innovations are audio-based educational applications, which replace or complement visual information with spoken instructions, auditory cues, and voice-guided learning interactions. These technologies are especially promising for visually impaired children because they align with the users' dominant sensory channel and can be accessed in flexible learning settings. Previous studies have shown that audio-based media can strengthen literacy development, improve comprehension, and increase access to learning materials for visually impaired learners in both formal and informal education contexts (Rimba et al., 2022; Sunarto & Elnawati, 2022; Hikmah, 2024). Audio learning applications therefore offer more than a compensatory tool; they represent a pathway toward more inclusive educational participation. Nevertheless, the effectiveness of such media depends not only on whether information is converted into sound, but also on how the system engages learners in an active learning process.

A major limitation in many existing audio-based applications is that they remain largely one-directional. They present information through speech output, but do not sufficiently respond to user performance, learning pace, or changing levels of understanding. In practice, this often reduces students to passive listeners rather than active learners. When applications lack two-way interaction, real-time feedback, and personalized adjustment, they do little to support the higher-order dimensions of independent learning, such as self-monitoring, self-correction, and gradual mastery. This limitation is especially significant for visually impaired children, who benefit from learning environments that can guide them step by step while still encouraging autonomous response and decision-making. Adaptive learning technologies provide a strategic answer to this challenge because they tailor the learning experience to user ability, response patterns, and progress over time (Graf, 2023; Kumar et al., 2024). Such

systems can increase motivation and retention, particularly among learners with special needs, by ensuring that tasks remain understandable, achievable, and appropriately challenging (Muller, 2016; Gevorgyan, 2024).

Within this context, Listen to Me emerges as a relevant platform for further development. Listen to Me is an audio-based educational application created to support visually impaired children by delivering learning content in non-visual form (Pratiwi et al., 2025). Its existence already reflects an important commitment to inclusive design, since it reduces dependence on visual cues and offers a more accessible channel for content delivery. However, initial evaluations indicate that the application still has significant limitations related to interactivity and adaptability. The current system does not automatically adjust the level of difficulty, provide immediate corrective feedback, or respond dynamically to learner performance. These shortcomings are crucial because accessible delivery alone does not guarantee effective learning autonomy. If a learner hears content but receives no meaningful response from the system, the learning process remains static and may fail to support sustained engagement or progressive achievement. Thus, Listen to Me provides a valuable foundation, but also reveals a clear opportunity for innovation.

Improving the application requires a shift from simple accessibility toward adaptive interactivity. For visually impaired learners, effective educational technology should incorporate responsive audio navigation, simple command structures, gradual content sequencing, and instant feedback that helps users recognize errors and make corrections independently (Sasing et al., 2021). These features are essential because they reduce the need for constant external mediation while helping learners remain oriented, motivated, and aware of their own progress. The integration of adaptive interactive elements into Listen to Me through user-centered design can make the application more aligned with the real experiences and preferences of visually impaired children (Zahib et al., 2022). A user-centered approach is important because accessibility cannot be assumed from technical design alone; it must be informed by the ways learners actually interact with content, interpret instructions, and respond to challenges in real learning situations.

The need for this development is further strengthened by a clear gap in current research and practice. Although audio-based applications are increasingly available, many still do not include adaptive mechanisms such as automated content adjustment, real-time performance analysis, or self-practice repetition based on user needs (Pardo et al., 2025). As a result, the field has progressed in making content more accessible, but has not advanced sufficiently in making learning more responsive and autonomy-supportive. This gap is particularly important for visually impaired children, whose learning success often depends on how well digital systems can replace not only visual information, but also the moment-to-moment instructional support usually provided by teachers or assistants. A more responsive audio learning application could strengthen intrinsic motivation, offer personalized learning challenges, and create conditions in which students practice independence in a structured yet flexible environment. In this sense, the enhancement of Listen to Me is not simply a software improvement, but an intervention in the broader effort to build equitable and empowering learning systems for children with disabilities.

To ensure that such innovation is developed systematically, this study adopts a Research and Development approach using the waterfall model, which includes stages of needs analysis, design, implementation, testing, and evaluation (Septyanto et al., 2020). This approach is appropriate because the study does not only seek to describe a problem, but also to produce and assess a functional prototype that meets pedagogical and accessibility requirements. The research is therefore situated at the intersection of inclusive education, assistive technology, and learner autonomy. It also contributes to the broader global agenda of equal educational opportunity, particularly the commitment to inclusive and equitable quality education for

children with disabilities as emphasized in the Sustainable Development Goals and related inclusive education initiatives (Johnstone et al., 2024).

Based on this background, the study focuses specifically on developing adaptive interactive features in the Listen to Me application to strengthen the independent learning of visually impaired children. The objectives of the research are to design and develop an adaptive interactive version of the Listen to Me application that is accessible and responsive to learner performance, and to examine how the integration of adaptive audio navigation, automated feedback, and progressive content adjustment can support learning autonomy among visually impaired children. To attain these objectives, the study addresses two research questions: first, how can adaptive interactive features be designed and implemented in the Listen to Me application to meet the accessibility and learning needs of visually impaired children? Second, to what extent can the developed application support independent learning through enhanced interaction, real-time feedback, and adaptive content delivery?

The novelty of this study lies in its effort to move beyond conventional audio-based accessibility by integrating adaptive interactivity into an existing application for visually impaired learners. Rather than treating audio as a one-way substitute for visual content, this research positions audio technology as a dynamic, responsive, and autonomy-oriented learning environment. In doing so, it offers a new contribution to assistive educational technology by combining accessibility, personalization, and learner independence within a single development framework.

RESEARCH METHOD

Research Design

This study employs the Research and Development (R&D) method, focusing on the development of adaptive interactive features for the *Listen to Me* application to support independent learning among visually impaired children. The R&D approach was selected because it not only yields a tangible product but also involves a systematic evaluation process to assess its feasibility and effectiveness (Waruwu, 2024). The research was conducted at Sekolah Luar Biasa (SLB) Pringsewu, Lampung, a specialized educational institution for students with disabilities, including visual impairments. This location was purposively selected as the target users visually impaired students have prior experience with audio-based learning, allowing the application to be tested within an authentic educational environment.

The development process followed the Waterfall model, a sequential linear framework widely adopted in software engineering (Wisidagama & Marikkar, 2024). Known as a classic life cycle model, it emphasizes a structured and sequential flow where each stage must be completed before progressing to the next (Lestari & Komputer, n.d.). Its systematic nature supports thorough documentation and continuous evaluation, making it, as (Lestari & Komputer, 216) notes, “highly suitable for educational technology development that requires accessibility assurance for users with special needs.”

Accordingly, the research was carried out through five sequential and interrelated stages. *The first* stage, needs analysis, aimed to identify learning difficulties, media accessibility requirements, and the specific characteristics of independent learning for visually impaired children. *The second* stage, data collection, utilized direct observation and in-depth interviews to gather detailed insights into user interaction behaviours and the necessary functionalities of an audio-based interface. Building on these findings, *the third* stage involved application design, which included structuring the audio-based interface, developing adaptive mechanisms for adjusting difficulty levels, and tailoring interaction flows based on user performance. *The fourth* stage was coding, where the designed concepts were transformed into an operational application equipped with adaptive interactive features capable of providing real-time responses to user input. *Finally, the testing stage* was conducted, comprising expert validation and limited user trials with visually impaired students. This phase ensured the developed

product met criteria for feasibility, accessibility, usability, and effectiveness in facilitating independent learning.

The systematic workflow inherent in the R&D and Waterfall approaches ensures that each development stage is evidence-based and validated before proceeding. By adhering strictly to this model, the resulting application is expected to be technically reliable, pedagogically relevant, and highly accessible for visually impaired children, ultimately supporting inclusive and autonomous learning.

Research Stages

The development of adaptive interactive features in the *Listen to Me* application was conducted systematically through the Waterfall Model, a software development approach widely known as the sequential linear model or the classic life cycle. This model emphasizes a structured and orderly process in which each phase must be completed before moving to the next stage. Such a model was considered appropriate for this study because the development of an accessible learning application for visually impaired children requires careful planning, clear documentation, and gradual refinement at every stage. By following a sequential process, the research was able to ensure that the resulting application was not only technically functional but also aligned with the actual learning needs of users. In this study, the development process consisted of five major stages, namely needs analysis, data collection, application design, coding, and testing. Each stage played a distinct role in transforming the initial concept into a usable adaptive learning prototype.

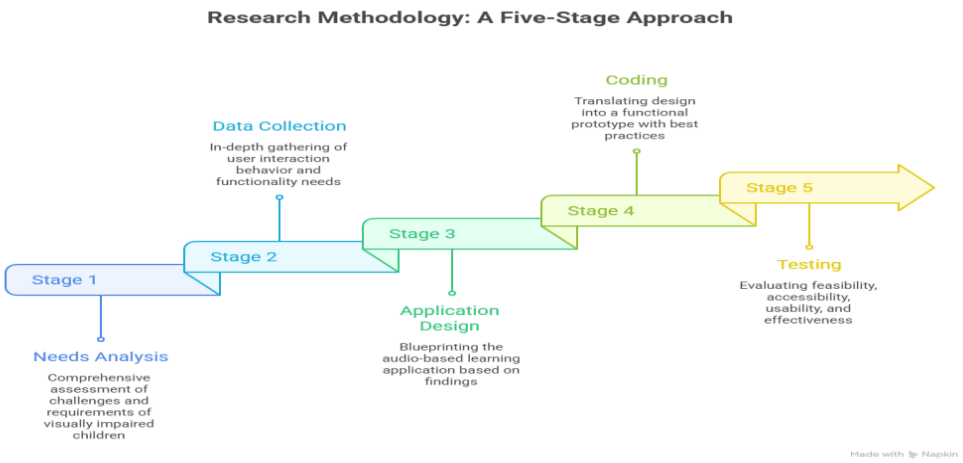

Figure 1. Development Stages

Figure 1 illustrates these development stages as a progressive sequence, beginning with Stage 1, namely needs analysis. This first stage served as the foundation of the entire research process because it focused on identifying the major challenges, limitations, and learning requirements experienced by visually impaired children. At this point, the researchers examined the barriers that learners commonly face when interacting with conventional digital learning media, especially those that rely heavily on visual elements. The needs analysis stage was crucial because it enabled the researchers to define the core problems that the application needed to address, such as limited accessibility, dependence on external assistance, and the lack of features that support independent learning. In other words, this stage ensured that the development process was grounded in real educational needs rather than merely driven by technical assumptions.

The second stage shown in Figure 1 is data collection, which functioned as a deeper investigation of user behavior and functional requirements. After identifying the general

problems in the needs analysis stage, the researchers gathered more detailed information regarding how visually impaired children interact with audio-based learning tools, what types of support they require, and which features are most relevant to their learning process. This stage was important because it provided evidence-based input for the design process. Data collection did not merely confirm the findings of the initial analysis, but also enriched them by revealing specific user expectations, usability considerations, and interaction patterns. As presented in the figure, this stage forms a bridge between problem identification and application development, ensuring that the proposed solution responds directly to user needs.

The third stage is application design, which is presented in Figure 1 as the blueprinting phase of the audio-based learning application. At this stage, the findings from needs analysis and data collection were translated into a conceptual and technical design. This included planning the structure of the application, determining the sequence of user interaction, and defining the adaptive interactive features to be embedded in the system. The design stage was especially significant because it transformed abstract user needs into concrete design elements, such as audio navigation, task flow, response mechanisms, and feedback features. For a learning application intended for visually impaired users, design is not limited to aesthetics or interface arrangement, but also involves accessibility logic, ease of command execution, and clarity of audio instructions. Therefore, this stage ensured that the application architecture supported both usability and learning autonomy.

The fourth stage in Figure 1 is coding, which refers to translating the design plan into a functional prototype using appropriate programming practices. In this phase, the researchers implemented the previously designed features into the *Listen to Me* application so that the system could operate as an adaptive interactive tool rather than as a static audio medium. Coding was a critical stage because it determined whether the conceptual design could be effectively realized in a digital environment. Through this phase, the application began to take shape as a working prototype capable of delivering structured audio content, receiving user input, and supporting interactive learning processes. The figure places coding after design to emphasize that technical implementation should only begin after the requirements and system structure have been clearly defined. This sequence reduced the risk of design inconsistency and ensured that development remained aligned with the research objectives.

The final stage presented in Figure 1 is testing, which focused on evaluating the feasibility, accessibility, usability, and effectiveness of the developed application. This stage was essential because the success of an educational technology product cannot be judged solely by whether it functions technically. Instead, it must also be assessed in terms of whether it is accessible to the target users, easy to operate, and beneficial for learning. In the context of this study, testing provided an opportunity to determine whether the adaptive interactive features in the *Listen to Me* application were able to support visually impaired children more effectively than a conventional one-way audio application. The testing stage also allowed the researchers to identify weaknesses, make refinements, and assess how far the prototype met the intended goals of promoting independent learning. As shown in Figure 1, testing appears as the culmination of the entire process, indicating that the final product is the result of a carefully ordered development pathway.

Data Analysis

The data analysis in this study employed a qualitative approach because the data were primarily derived from observations and interviews rather than numerical measurements. This approach was selected to generate an in-depth understanding of how visually impaired children interacted with the adaptive features developed in the *Listen to Me* application and how these features contributed to the growth of independent learning. Through qualitative analysis, the researchers were able to capture not only user responses, but also the meanings, experiences, and behavioural patterns that emerged during the implementation of the application.

Observation data were collected during product testing sessions conducted at SLB Pringsewu. In these sessions, the researchers closely examined how students operated the application, responded to audio instructions, completed learning tasks, and demonstrated levels of independence while using the system. Particular attention was given to user responsiveness, ease of navigation, barriers encountered, and the general learning atmosphere created by the application. The field notes produced from these observations were reviewed carefully and then categorized into recurring themes to identify patterns related to accessibility, usability, learner confidence, and the effectiveness of the adaptive interactive features.

Interview data were obtained from teachers and learning assistants who accompanied visually impaired students during the learning process. These informants were chosen because they possessed direct experience in observing student needs, learning behaviour, and the practical value of assistive media. The interviews aimed to gather professional insights regarding the usability of the application, the suitability of the learning content, and its potential to strengthen self-directed learning skills. After transcription, the interview data were analysed using content analysis by coding them into thematic categories, including learning motivation, comprehension, clarity of interaction, and overall application usability. To enhance the credibility of the findings, the results of observations and interviews were triangulated. This process enabled the researchers to compare evidence from different data sources and produce a more valid interpretation. Through this analysis, the study identified the practicality of the adaptive features, recognized areas for refinement, and drew conclusions regarding the feasibility of the application as an independent learning tool for visually impaired children.

RESEARCH FINDINGS AND DISCUSSION

Research Findings

This study successfully developed adaptive interactive features for the *Listen to Me* application to support independent learning among visually impaired children at Sekolah Luar Biasa (SLB) Pringsewu. The findings, structured according to the research stages needs analysis, data collection, application design, coding, and testing provide a comprehensive overview of the development process and the effectiveness of the implemented adaptive features.

Needs Analysis Stage

The needs analysis identified that limited access to appropriate learning media is the primary barrier to learning independence for visually impaired children (Douglas et al., 2016). Teachers reported that most learning tasks still require substantial assistance due to a heavy reliance on visual content or non-responsive audio-based media. Observations confirmed that students often became confused when using devices without clear audio guidance or structured, accessible navigation. Furthermore, learning remained passive because existing applications only delivered information one-way, without requiring active user involvement. Consequently, there is a clear need for auditory media that can respond interactively to user actions. These identified needs formed the foundation for designing features to genuinely enhance independent learning, aligning with the call for more responsive assistive technologies.

Data Collection Stage

Data were collected through direct classroom observation and in-depth interviews with teachers. The findings indicate that teachers expect digital tools that can partially assume the role of a learning assistant, particularly in delivering instructions and providing feedback. Observations also revealed that while students responded positively to audio-based media, they required systems capable of offering guidance during difficulties without depending on constant teacher support. These insights were translated into key functional requirements: voice-guided navigation, gradual content delivery, performance tracking, and automatic assessment

capabilities to facilitate self-paced practice, which are considered essential for fostering autonomy.

Application Design Stage

At this stage, the application interface was designed through a user-centered approach to ensure that visually impaired learners could access and operate the system comfortably, efficiently, and independently (Shoaib et al., 2024). Rather than relying on visual prompts or complex screen layouts, the interface was structured around auditory guidance, simple command logic, and intuitive interaction flows. The menu organization, navigation paths, and response patterns were therefore developed to function entirely through sound-based communication. This design choice was essential because visually impaired users require an interface that not only delivers information audibly, but also supports orientation, control, and confidence during the learning process. In this context, accessibility was treated not as an additional feature, but as the core design principle shaping the overall architecture of the application.

The central innovation of the application lies in the integration of four adaptive features that transform the platform into a more responsive and personalized learning environment. This direction is consistent with Graf (2023), who emphasizes that learning experiences become more effective when they are adjusted to user ability and pace. The voice command system allows learners to operate the application through speech, reducing dependence on touch-based screen recognition and enabling more natural interaction. The progress tracker records student achievement and provides performance updates, which can reinforce motivation, build confidence, and help learners become more aware of their own development. At the same time, the adaptive learning interface adjusts the level of task difficulty based on individual performance so that students are neither overwhelmed nor underchallenged. Complementing these functions, the virtual tutor system provides immediate feedback and correction, encouraging users to remain engaged and actively involved in the learning process.

Through the integration of these features, the application moves beyond a conventional audio tool and becomes an interactive educational medium that responds to individual learner needs. This transformation is especially important because meaningful inclusion requires more than access alone; it requires learning environments that actively support participation, independence, and personal growth (Layachi & Pitchford, 2025).

Coding Stage

The coding stage implemented the designed features into an Android-based audio learning application. The focus was on ensuring high-quality, clearly articulated audio instructions and fast system responses to student commands. Development prioritized accessibility principles, including accurate voice command recognition and efficient audio processing. Continuous functional testing was conducted to eliminate navigation errors, content delivery issues, and feedback delays. Iterative improvements were applied until the application met functional readiness and user accessibility standards, following the systematic ethos of the R&D waterfall model

Testing Stage

Testing involved expert validation and limited trials with visually impaired students. Experts confirmed the application met criteria for instructional clarity, content relevance, and accessibility. Teachers positively evaluated the system's ability to provide understandable, step-by-step guidance. User trials demonstrated that students could operate the application independently, indicating the effectiveness of the Voice Command feature. Moreover, automatic difficulty adjustment and real-time feedback from the Virtual Tutor enhanced student engagement and comprehension. Students showed increased enthusiasm and participation

compared to their experiences with conventional one-way audio applications, echoing findings that interactive audio tools improve literacy and engagement.

Discussion

The findings of this study indicate that the adaptive interactive features integrated into the *Listen to Me* application substantially strengthened the independent learning capacity of visually impaired children. This improvement was reflected in students' increased ability to navigate learning content, respond to instructions, and complete tasks with reduced reliance on teachers or assistants. These results confirm earlier arguments that learning independence among children with disabilities is strongly influenced by the accessibility of the learning environment and the extent to which media can support self-regulation rather than dependency (Daulay et al., 2022; Salwa et al., 2025). In this study, independence did not emerge merely because the content was available in audio form, but because the application created a structured interaction system that guided students through tasks while still allowing them to make decisions and progress autonomously. This extends prior literature showing that accessibility alone is insufficient if it does not also promote agency, confidence, and self-directed engagement (Egilson, 2009).

The needs analysis stage revealed that visually impaired students continued to face major barriers when engaging with digital learning materials that were designed primarily for sighted learners. Teachers reported that students often required significant assistance because many existing media either depend on visual presentation or deliver audio in a static, one-way manner. These findings are consistent with the work of Aftab and Ghaffar (2025), who note that educational content remains heavily visual and therefore often inaccessible to learners with visual impairments. They also support Douglas et al. (2011), who emphasize that limited access to appropriate literacy materials continues to hinder the learning participation of visually impaired children and young people. However, the present study goes further by demonstrating that the challenge is not only access to content, but also access to interactive pedagogical support. In other words, the results suggest that the problem is not solved simply by converting text or visual material into sound. Effective support for visually impaired learners requires media that can respond to learner actions, provide guidance, and scaffold understanding in real time.

The positive response to the audio-based environment confirms earlier studies that have identified the value of auditory learning media for visually impaired students. Previous research has shown that audio-based applications can improve comprehension, literacy access, and learning participation by aligning instructional delivery with the dominant sensory channel of visually impaired learners (Saputra Rimba et al., 2022; Sunarto & Elnawati, 2022; Hikmah et al., 2024). The findings of the present study support this conclusion, as students were able to engage more confidently when instructions and navigation were delivered through clear auditory cues. Nevertheless, this study also extends those earlier findings by showing that the educational value of audio media increases significantly when it becomes interactive and adaptive. Earlier audio applications often functioned as passive delivery tools, whereas *Listen to Me* enabled users to control the learning process, receive feedback, and experience adjusted task progression. This suggests that future assistive audio technologies should not be conceptualized simply as replacements for visual materials, but as intelligent learning environments capable of supporting participation and autonomy.

A particularly important finding of this study is that the voice command system enabled students to operate the application more independently, thereby reducing one of the most persistent barriers in mobile learning for visually impaired users, namely dependence on screen position awareness and touch accuracy. This result is consistent with Shoaib et al. (2024), who found that mobile learning applications for visually impaired children are more effective when accessibility is embedded into the interface design from the beginning. It also aligns with Sasing

et al. (2021), who emphasize the importance of clear auditory guidance and accessible interaction patterns in mobile learning tools for visually impaired students. However, the present findings contribute something further by demonstrating that voice-based control is not only an accessibility tool, but also a mechanism for strengthening learner autonomy. By allowing students to access menus, navigate content, and respond to tasks through speech, the system reduced hesitation and encouraged more active exploration. This indicates that user-centered design for visually impaired learners should prioritize interactive control mechanisms that foster confidence and self-efficacy, not merely usability.

The adaptive learning interface and virtual tutor system were also central to the study's findings. Students were more engaged when task difficulty adjusted to their performance and when the system provided immediate responses to their answers. These outcomes strongly support the broader literature on adaptive learning technologies, which argues that personalization enhances learning effectiveness by matching content to learner ability and pace (Graf, 2023; Kumar et al., 2024). Gevorgyan (2024) similarly reports that adaptive learning systems can increase participation and educational inclusion for learners with special needs because they make learning more responsive and individualized. In the present study, adaptive sequencing prevented students from becoming overwhelmed by tasks that were too difficult or disengaged by tasks that were too simple. Meanwhile, the virtual tutor supported error correction and comprehension in the moment, reducing the need to wait for teacher intervention. These findings therefore confirm that adaptive technology can improve both motivation and retention, especially when learners require flexible support structures (Muller, 2016; Nisar Ahmad Koka et al., 2023). At the same time, the study extends previous work by applying this principle specifically within an audio-based environment for visually impaired children, an area that remains underdeveloped in the assistive learning literature.

Another significant contribution of this study lies in its implications for inclusive classroom practice. Teachers and learning assistants reported that the application was able to assume part of the instructional and feedback function that is usually performed by adults. This is important because many inclusive and special education contexts are still highly dependent on human mediation, especially when learners need help interpreting inaccessible materials. The present findings suggest that adaptive educational technology can redistribute some of this instructional burden, allowing teachers to devote more attention to emotional support, encouragement, and individualized pedagogical relationships. This aligns with Layachi and Pitchford (2025), who argue that personalized learning technology can support more equitable access and participation for children with special educational needs and disabilities. It also resonates with Johnstone et al. (2024), who discuss inclusive education not only as physical access to schooling, but as the provision of meaningful opportunities to participate and succeed. In this respect, *Listen to Me* appears to function not only as a learning aid, but also as a practical tool for supporting more sustainable inclusive teaching.

The findings of this study do not fundamentally contradict previous research; rather, they confirm and extend it in a meaningful way. Prior studies have consistently shown that accessible media, user-centered design, and adaptive technology each contribute positively to learning for students with disabilities (Graf, 2023; Shoaib et al., 2024; Layachi & Pitchford, 2025). What this study adds is evidence that these dimensions become more powerful when integrated into a single platform specifically designed for visually impaired children. The combination of voice command, progress tracking, adaptive difficulty adjustment, and real-time virtual tutoring distinguishes *Listen to Me* from many earlier auditory tools that addressed only one aspect of accessibility or instruction. The progress tracker, in particular, adds a metacognitive dimension by helping learners monitor achievement and recognize improvement over time. This element contributes to self-awareness and motivation, which are key dimensions of independent learning but are often overlooked in assistive technology design.

The results demonstrate that the *Listen to Me* application represents a meaningful advancement in assistive learning technology for visually impaired children. Its effectiveness lies not simply in making content audible, but in transforming audio into an adaptive, interactive, and learner-centered educational experience. The study therefore supports the view that inclusive educational technology should move beyond access toward empowerment. By helping visually impaired students participate more actively, learn at their own pace, and rely less on constant external support, the application contributes to both academic development and broader life skills associated with autonomy and self-management. In this sense, the findings extend the current body of knowledge by showing that the future of inclusive audio-based learning lies in personalization, responsiveness, and meaningful interaction rather than in one-way accessibility alone.

CONCLUSION

This study successfully developed an adaptive interactive feature innovation in the *Listen to Me* application as an independent learning medium for visually impaired children. The introduced innovations include a Voice Command System for voice-based navigation, a Progress Tracker to monitor individual learning achievements, an Adaptive Learning Interface capable of adjusting difficulty levels and content based on user needs, and a Virtual Tutor System that provides real-time feedback. The integration of these four features has resulted in an application that is more responsive, accessible, and capable of offering a personalized learning experience, overcoming the limitations of previous audio-based applications that tended to be one-directional.

Based on the results of observations and interviews, the application has been proven to enhance the learning independence of visually impaired children. With the presence of these features, dependency on assistants can be reduced, while users' confidence in exploring learning materials increases significantly. Furthermore, the embedded adaptive mechanism enables each child to learn according to their own pace and capability, making the learning process more effective and meaningful.

This study provides a tangible contribution to the development of inclusive educational technology, particularly for visually impaired learners. For future development, further studies are recommended to examine the application's long-term effectiveness and to expand both the material coverage and supporting features. This is necessary to ensure that the application can continuously adapt to increasingly complex learning needs. Additionally, a strategic direction for future enhancement may include the integration of more advanced artificial intelligence to increase the level of personalization in learning services for visually impaired users.

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INFORMED CONCENT STATEMENT

Participation in this study is entirely voluntary. By agreeing to take part, the participants acknowledge that they have been informed about the purpose, procedures, potential risks, and benefits of the study.

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