Innovative Mobile Application and Training Kit for Teaching Hijaiyyah Letters to Deaf and Mute Students: A Technology-Based Approach

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ABSTRACT

Recognising and learning Hijaiyyah letters is fundamental for Quranic literacy among deaf and mute students. However, traditional teaching methods lack inclusivity, relying on auditory and verbal instruction, which poses challenges for students with hearing impairments. This study introduces an innovative mobile application and training kit designed to enhance Hijaiyyah letter recognition and learning through a technology-based approach. The application integrates interactive visual aids, sign language animations, gamified learning modules, and real-time feedback to support individualised learning. The training kit includes tactile learning tools, flashcards, and sign language reference materials to reinforce digital learning with hands-on experiences. A mixed-method research design was employed, incorporating pre- and post-assessment tests with a sample of deaf and mute students in special education settings. Findings indicate significant improvement in letter recognition, retention, and engagement among participants using the proposed learning model. Educators also highlighted the effectiveness of integrating visual, interactive, and kinaesthetic learning strategies. This study contributes to special needs education, Islamic pedagogy, and educational technology by providing a scalable model for enhancing Quranic literacy through digital innovation. Future recommendations include AI-driven adaptive learning, real-time sign language translation, and cloud-based accessibility to further improve inclusivity in Islamic education.

Keywords: Hijaiyyah Letters, Deaf and Mute Students, Assistive Technology, Mobile Learning, Special Needs Education, Quranic Literacy

INTRODUCTION

Islamic education plays a crucial role in shaping the understanding and practice of faith among Muslims. Mastering *Hijaiyyah* letters is a fundamental aspect of Quranic literacy. However, for deaf and mute students, learning these letters poses a significant challenge due to the reliance on auditory and verbal instruction in traditional teaching methods (Mustafa Che Omar et al., 2015). Therefore, it is essential to implement innovative teaching methods that ensure accessibility and inclusivity in special needs education.

Special education in Malaysia has evolved significantly, integrating digital technology and interactive teaching aids. Research has demonstrated that incorporating technology into Quranic education for deaf students enhances their understanding through visualisation, sign language, and interactive materials (Norlidah Alias et al., 2022). Mobile applications provide a multisensory approach by integrating visual elements, sign language animations, text-based instruction, and interactive exercises, while training kits complement these tools with tactile learning materials designed to cater to the unique learning needs of these students (Mustaffar Abd Majid & Nor ‘Azah Ahmad Safran, 2017).

As educational technology continues to advance, mobile applications and interactive training kits have proven effective in enhancing learning for students with disabilities, including those with hearing and speech

impairments (Mustaffar Abd Majid & Nor 'Azah Ahmad Safran, 2017). Mobile applications provide a multisensory approach, integrating visual elements, sign language animations, text-to-speech features, and interactive exercises, allowing deaf and mute students to better recognise and pronounce *Hijaiyyah* letters. Training kits complement this by offering interactive flashcards, visual textbooks, and tactile learning materials, specifically designed to cater to the unique learning needs of these students.

According to a study by Abdul Munir Ismail (2012), communication methods for the deaf vary depending on their ability to comprehend sign language and other visual approaches. Thus, an effective teaching system for deaf students learning *Hijaiyyah* letters must incorporate a combination of technology and visual-based instruction to align with their communication abilities. One recommended approach is the use of animated sign language, where each *Hijaiyyah* letter is presented using hand gestures that are easily understood by deaf students. This is supported by Llamazares de Prado (2021), who highlights the importance of assistive technology in language learning, emphasising that hybrid technology approaches facilitate access to education and enhance sign language literacy.

Additionally, the use of assistive technology in Quranic education for deaf students has gained attention in previous studies (Nasir & Afendi, 2016). Assistive technologies such as interactive smartboards, artificial intelligence (AI)-powered applications, and gesture recognition systems make the learning process more dynamic and effective. For example, research by Shoba S. et al. (2024) found that an AI-powered application integrating gesture recognition for sign language learning significantly improved comprehension among deaf students. A similar approach can be applied in *Hijaiyyah* letter learning to ensure students can visually recognise, understand meanings, and practice pronunciation with greater clarity. Furthermore, a study by Liñan-Espinoza & Andrade-Arenas (2024) suggests that mobile applications designed for students with hearing impairments enhance their learning experience through interactive features, ensuring inclusive and equitable education.

Furthermore, there are challenges in teaching the Quran to deaf students, including the lack of suitable teaching aids, limited availability of teachers proficient in sign language, and low student motivation due to difficulties in understanding Arabic text without sufficient guidance (Muhammad Sayuti Sabdan et al., 2022). Hence, the development of a mobile application and interactive training kit not only enhances student comprehension but also aids educators in delivering lessons more effectively. Siong et al. (2021) propose that mobile learning applications play a vital role in language education for the hearing-impaired, which can be adapted to the teaching of *Hijaiyyah* letters.

Beyond pedagogical aspects, the effectiveness of technology in enhancing student motivation has also been demonstrated in numerous studies. According to Nur Syarafina Binti Abdul Rahman et al. (2020), digital learning tools and interactive technology increase students' engagement and focus. In the context of learning *Hijaiyyah* letters, motivation is a key factor, as deaf students often struggle with memory retention and letter recognition due to their inability to rely on auditory learning (Nik Hassan et al., 2015). Therefore, an application and training kit incorporating gamification elements, interactive exercises, and digital reward systems can significantly enhance student engagement and enjoyment in learning Hijaiyyah letters. Furthermore, Elmahmoudi et al. (2021) highlight that smart classroom technologies tailored to students with speech and hearing disabilities can further improve their educational outcomes.

In conclusion, the development of a mobile application and training kit for teaching *Hijaiyyah* letters to deaf and mute students is a much-needed innovation in special education and Islamic education. By integrating visual, interactive, and assistive technology-based approaches, this initiative not only facilitates better comprehension of *Hijaiyyah* letters among deaf students but also contributes to the advancement of inclusive education in Islam. This study will further explore the proposed learning model, research methodology, and an analysis of the effectiveness of the mobile application and training kit in helping deaf and mute students systematically master *Hijaiyyah* letters.

Objectives Of the Study

This study aims to evaluate the effectiveness of a mobile application and an interactive training kit in enhancing the learning of *Hijaiyyah* letters among deaf and mute students. The objectives of this research are as follows:

1. To analyse the effectiveness of the mobile application and interactive training kit in enhancing the understanding and mastery of *Hijaiyyah* letters among deaf and mute students.

2. To develop and evaluate the design of a mobile application and training kit based on interactive, visual, and gamification technology to support inclusive *Hijaiyyah* letter learning.

3. To identify the challenges and user needs in utilising the mobile application and training kit to ensure its effectiveness and acceptance in the context of special Islamic education.

BACKGROUND OF THE STUDY

Special education has undergone significant development over the past decades to ensure that students with special needs, including deaf and mute learners, have access to quality education. In the context of Islamic education, learning *Hijaiyyah* letters poses a major challenge for deaf and mute students because traditional Quranic teaching methods rely heavily on listening and verbal pronunciation (Mustafa Che Omar et al., 2015). Therefore, new approaches are required to help these students recognise, understand, and read *Hijaiyyah* letters more effectively. This study explores the development of a mobile application and training kit as an innovative alternative to enhance the learning of *Hijaiyyah* letters among deaf and mute students.

Challenges in Learning Hijaiyyah Letters for Deaf and Mute Students

A study by Norlidah Alias et al. (2022) found that the Islamic education curriculum for deaf students remains inadequate because it still employs *talaqqi* and *musyafahah* approaches, which require verbal and auditory interaction between teachers and students. This makes learning difficult for deaf students, as they cannot hear the phonetic sounds of *Hijaiyyah* letters and struggle to differentiate between *makhraj* (articulation points). In research conducted by Nik Hassan et al. (2015), Islamic education teachers admitted that suitable teaching materials (BBM) for deaf students remain limited, making it difficult to teach proper tajwid and pronunciation.

Another significant challenge is the lack of teachers proficient in sign language. Most Islamic education teachers have not received formal training in Malaysian Sign Language (BIM), making communication with deaf students more difficult (Abdul Munir Ismail, 2012). As a result, students rely solely on textbooks and static visuals, which are not interactive enough to improve their understanding of *Hijaiyyah* letters. Therefore, visual and technology-assisted methods are needed to help deaf students grasp *Hijaiyyah* letters more effectively.

Technology as an Alternative in Special Education

Technological advancements have paved the way for the use of mobile applications and assistive technology in special education. A study by Mustaffar Abd Majid & Nor ‘Azah Ahmad Safran (2017) found that integrating assistive technology in teaching special needs students significantly improves their understanding compared to conventional methods. Developments in technology, such as digital interactive boards, artificial intelligence (AI), and gesture recognition systems, have enabled deaf students to learn concepts more dynamically rather than being limited to passive learning through textbooks alone.

One successful example of technology in deaf education is AI-powered applications that can recognise sign language automatically. A study by Shoba S. et al. (2024) found that real-time AI-powered sign language recognition in special education significantly enhanced deaf students’ comprehension of language learning. A similar approach can be applied in *Hijaiyyah* letter learning, where each letter can be translated into animated hand signs and displayed interactively via a mobile application.

Additionally, gamification in education has proven to be effective in increasing student motivation. According to a study by Nur Syarafina Binti Abdul Rahman et al. (2020), students who used digital learning platforms with gamification elements showed increased focus and interest in the subjects they studied. In the context of learning *Hijaiyyah* letters, features such as interactive quizzes, daily challenges, and a digital reward system can encourage students to engage actively in their learning.

Furthermore, studies by Llamazares de Prado (2021) emphasise the role of assistive technology in sign language education, supporting the idea that technology enhances accessibility and engagement in learning. Similarly, Siong et al. (2021) highlight the importance of mobile learning applications for sign language education, which can be adapted for teaching *Hijaiyyah* letters. In addition, Elmahmoudi et al. (2021) discuss how smart classroom technology can facilitate learning for students with hearing and speech disabilities, providing further support for integrating digital tools in Islamic education.

The Need for a Mobile Application and Training Kit for *Hijaiyyah* Learning

Given the challenges and potential of technology in special education, there is an urgent need to develop a mobile application and interactive training kit tailored for learning *Hijaiyyah* letters among deaf and mute students. This application should include the following elements:

1. To assess the impact of mobile-based learning on the recognition and retention of *Hijaiyyah* letters among deaf and mute students.

2. To examine the effectiveness of interactive and gamified learning approaches in improving student engagement and motivation.

3. To evaluate teachers' perceptions, challenges, and adaptability in integrating assistive technology into special education classrooms.

4. To identify key challenges in implementing digital learning solutions and propose solutions for future improvements.

According to Muhammad Sayuti Sabdan et al. (2022), implementing technology in Quranic education for deaf students requires a holistic approach involving teachers, parents, and the special education community to ensure long-term success. Therefore, in addition to developing an application and training kit, teacher training and parental involvement are crucial to ensure the effectiveness of these tools in enhancing students' ability to read *Hijaiyyah* letters.

This background study highlights that teaching *Hijaiyyah* letters to deaf and mute students continues to face multiple challenges in terms of curriculum, teaching resources, and communication effectiveness between teachers and students. Technological advancements have provided innovative alternatives through mobile applications and interactive training kits, which can help improve student comprehension and engagement in learning Hijaiyyah letters. Therefore, this study aims to develop and evaluate the effectiveness of a new learning model that integrates digital technology with Islamic special education, ultimately ensuring that Quranic education becomes more inclusive and accessible to all students.

LITERATURE REVIEW

Research on *Hijaiyyah* learning for deaf and mute students has gained attention in the fields of special education and educational technology. Various approaches have been proposed by researchers to help this group master *Hijaiyyah* letters more effectively, including interactive teaching aids (BBM), visual and kinaesthetic learning strategies, and mobile applications. This section reviews past studies related to three key aspects: the challenges of learning *Hijaiyyah* among deaf and mute students, the role of technology in special education and innovations in Quranic teaching for hearing-impaired students.

Challenges in Learning *Hijaiyyah* for Deaf and Mute Students

Past studies have shown that deaf and mute students face significant difficulties in learning *Hijaiyyah* letters due to the lack of specialised teaching methods that cater to their needs. The reliance on traditional Quranic teaching approaches, such as *talaqqi* and *musyafahah,* requires verbal interaction between teachers and students, making it inaccessible for those with hearing impairments (Mustafa Che Omar et al., 2015). Additionally, the lack of

teachers proficient in sign language further exacerbates the issue, limiting effective communication and instruction (Abdul Munir Ismail, 2012).

Furthermore, a study by Norlidah Alias et al. (2022) revealed that most deaf students lack access to appropriate teaching materials, making them rely solely on written texts without visual or sign language support. The lack of teachers proficient in sign language is another significant barrier, as highlighted by Abdul Munir Ismail (2012), who emphasised that Islamic education teachers often lack formal training in sign language, making communication with deaf students difficult.

Additionally, in a study conducted by Nik Hassan et al. (2015), it was found that deaf students struggle to recognise and memorise *Hijaiyyah* letters because they cannot hear the differences in phonetic sounds. Therefore, visual and tactile approaches, such as colour-coded flashcards or embossed printed materials, can assist them in distinguishing letters based on shape and texture.

The Role of Technology in Special Education

Technological advancements have significantly improved learning experiences for special needs students. Assistive technologies such as AI-powered applications, interactive smartboards, and gamification elements have been proven to enhance student engagement and comprehension (Shoba S. et al., 2024). In Quranic education, AI-driven applications have facilitated real-time sign language translation and gesture recognition, making learning more accessible for deaf students (Nasir & Afendi, 2016).

One of the most successful technological applications in special education is the use of artificial intelligence (AI) for sign language recognition. A study by Shoba S. et al. (2024) demonstrated that AI applications capable of automatically recognising hand gestures have greatly improved language learning outcomes among deaf students. This approach can be applied to *Hijaiyyah* learning, where AI can be used to translate sign language into written letters or digital speech output.

Moreover, gamification in education has proven effective in increasing motivation among deaf students. A study by Nur Syarafina Binti Abdul Rahman et al. (2020) found that digital learning platforms incorporating gamification elements enhance student engagement and interest in learning. In the context of *Hijaiyyah* learning, features such as interactive quizzes, reward systems, and themed challenges can help sustain student motivation and active participation.

A study by Mohd Nizam et al. (2020) further found that mobile applications in special education help deaf students understand difficult concepts more clearly. The use of technology such as augmented reality (AR) and virtual reality (VR) in educational applications allows students to interact with *Hijaiyyah* letters in a 3D environment, providing a more immersive learning experience.

Additionally, research by Llamazares de Prado (2021) emphasises that assistive technology plays a crucial role in improving sign language education, supporting the integration of digital tools into special education. Similarly, Siong et al. (2021) highlight the importance of mobile learning applications for sign language education, which can be adapted for teaching *Hijaiyyah* letters. Furthermore, Elmahmoudi et al. (2021) discuss how smart classroom technology can facilitate learning for students with hearing and speech disabilities, providing further support for integrating digital tools in Islamic education.

Innovations in Quranic Teaching for Deaf Students

Recent research highlights the effectiveness of interactive and visual teaching methods in Quranic education. The use of animated hand signs for each *Hijaiyyah* letter, digital rewards, and augmented reality applications has shown promising results in enhancing student motivation and comprehension.

Additionally, in a study by Nasir & Afendi (2016), it was suggested that technology-based learning modules

could enhance deaf students' understanding of tajwid and pronunciation. This study showed that applications featuring interactive elements such as speech recognition and self-assessment could help students grasp the correct pronunciation of *Hijaiyyah* letters.

Several studies highlight the effectiveness of integrating visual learning strategies into Quranic education. The use of animated hand signs, gamification features, and augmented reality applications has significantly improved student motivation and comprehension (Zulkifli et al., 2021). Furthermore, interactive modules that incorporate speech recognition and self-assessment tools provide a more engaging learning experience for deaf and mute students (Nur Syarafina Binti Abdul Rahman et al., 2020).

In conclusion, past studies indicate that deaf students face multiple challenges in learning *Hijaiyyah* letters, including limited access to appropriate teaching materials, difficulty in distinguishing letter sounds, and a shortage of teachers trained in sign language. However, technological advancements have introduced various innovative alternatives such as mobile applications, artificial intelligence, gamification, and virtual reality, which can help enhance the understanding and engagement of deaf students in *Hijaiyyah* learning. Therefore, this study aims to develop a more inclusive, technology-driven, and interactive learning model to improve the effectiveness of teaching *Hijaiyyah* letters to deaf and mute students.

RESEARCH METHODOLOGY AND STUDY DESIGN

This study employs a mixed-methods approach, combining quantitative and qualitative data collection methods. Fifty deaf and mute students from several special education schools in Malaysia participated, divided into an experimental group using the mobile application and training kit and a control group using traditional methods.

To ensure a comprehensive analysis of the effectiveness of this technological approach, 50 deaf and mute students from several special education schools in Malaysia were selected as participants. The sample selection considered students who faced challenges in visually and kinaesthetically identifying *Hijaiyyah* letters, based on previous research that highlighted the ineffectiveness of traditional learning methods for deaf students (Mustafa Che Omar et al., 2015). Additionally, 10 special education teachers participated in this study to provide feedback on the practicality and challenges of integrating the mobile application and training kit into classroom instruction. Teachers play a crucial role as facilitators in *Hijaiyyah* letter instruction, and their ability to effectively utilise this technology significantly influences students' acceptance and comprehension of the new learning method.

The primary instruments used in this study included a mobile learning application specifically developed for *Hijaiyyah* letter instruction. This application incorporated various interactive elements, such as animated sign language for each letter, visual quizzes and interactive exercises, and synthetic audio for students who use hearing aids. Additionally, a physical training kit was employed as a complementary tool, consisting of embossed flashcards to help students recognise letter shapes through touch and a structured writing module to enhance kinaesthetic learning.

Research Phases

The study was conducted in four key phases to systematically evaluate the effectiveness of the mobile application and training kit:

Preliminary Research and Data Collection Initially, a literature review was conducted to identify the main challenges faced by deaf and mute students in learning *Hijaiyyah* letters. Previous studies have shown that the lack of teaching materials tailored to the needs of disabled students, combined with a shortage of teachers proficient in sign language, makes it difficult for deaf students to master *Hijaiyyah* letters (Norlidah Alias et al., 2022). To address these issues, initial data were collected through a survey distributed to special education teachers to assess the weaknesses of existing teaching methods.

Implementation of the Mobile Application and Training Kit

Following data collection, the second phase of the study involved the implementation of the mobile application

and training kit by the experimental group. These students used the application and training kit for eight weeks, while the control group continued with traditional methods. During this period, teachers played a crucial role in guiding and monitoring students' progress, ensuring that they used the technology correctly. This phase also examined the challenges faced by teachers in adapting to the technology, as the success of educational innovations in special needs education depends significantly on teachers' ability to integrate them into their teaching strategies (Mustaffar Abd Majid & Nor 'Azah Ahmad Safran, 2017).

Evaluation of Learning Outcomes and Data Analysis

The third phase focused on testing and evaluating the effectiveness of the application and training kit in helping deaf students comprehend Hijaiyyah letters. At the end of the eight-week period, post-tests were conducted for both groups to determine improvements in letter recognition and memorisation skills. Quantitative data from these assessments were analysed using statistical software to compare the learning outcomes between the experimental and control groups. Simultaneously, in-depth interviews were conducted with teachers and students to gather qualitative insights on the strengths and limitations of the mobile application and training kit.

Discussion and Interpretation of Findings

The final phase of the study involved data analysis and discussion of findings. The results from test scores and interviews were analysed to determine the extent to which the technology-based approach enhanced students' understanding of *Hijaiyyah* letters. A previous study by Shoba S. et al. (2024) demonstrated that mobile applications incorporating visual and interactive elements significantly improved language comprehension among deaf students. Therefore, this study compared its findings with previous research to identify common trends and unique contributions in the use of technology for special education in Islamic learning.

Data Collection and Analysis

This study utilised both quantitative and qualitative data collection methods to ensure a holistic evaluation:

1. Pre-test and Post-test Assessments: Students' initial knowledge of *Hijaiyyah* letters was assessed before the implementation of the mobile application and training kit. After eight weeks of usage, a post-test was conducted to measure improvements in letter recognition and retention. The difference in test scores between the experimental and control groups was analysed using statistical methods.

2. Observational Analysis: Teachers observed students' engagement, confidence, and interaction with the learning materials throughout the study. Their observations provided insights into the usability and effectiveness of the mobile application and training kit.

3. Student and Teacher Interviews: Structured interviews were conducted with students and teachers to understand their experiences, challenges, and perceptions of the new learning method. Teachers provided feedback on the ease of integration into the curriculum, while students shared their engagement and learning progress.

4. Surveys: Questionnaires were distributed to both students and teachers to evaluate their satisfaction levels and perceived effectiveness of the mobile application and training kit.

Ethical Considerations

To ensure ethical compliance, the study adhered to the following guidelines:

1. Informed consent was obtained from participants and their guardians before the study commenced.

2. Confidentiality and anonymity of all participants were maintained.

3. The research design ensured that participation was voluntary and that students had the option to withdraw at any time without any consequences.

In conclusion, the research design of this study aims to provide a comprehensive evaluation of the impact of mobile learning applications and interactive training kits on the learning process of Hijaiyyah letters for deaf and mute students. The findings of this study are expected to not only enhance the understanding of how technology can be effectively used in special needs Islamic education but also to serve as a reference for the development of a more inclusive curriculum that meets the specific needs of deaf students. By implementing a more innovative approach to *Hijaiyyah* letter instruction, deaf and mute students can experience a more engaging, accessible, and effective learning process that caters to their unique learning needs.

FINDINGS OF THE STUDY

This study aimed to evaluate the effectiveness of a mobile application and training kit in enhancing the learning of Hijaiyyah letters among deaf and mute students. The research employed a mixed-method approach, incorporating quantitative assessments, qualitative feedback, and observational analysis to measure the impact of technology-driven learning on special needs education. The findings provide insights into the learning improvements, student engagement, teacher perspectives, and challenges in implementing assistive technology for Hijaiyyah letter instruction.

Improvements in Letter Recognition and Retention

The results of the study indicate a significant improvement in letter recognition and retention among students who used the mobile application and training kit. Before using the technology-assisted learning tools, 78% of students experienced difficulty in distinguishing visually similar *Hijaiyyah* letters, such as ب (Ba), ت (Ta), and ث (Tha). However, after eight weeks of structured learning, 85% of students exhibited enhanced differentiation skills. This aligns with previous research emphasising the importance of multisensory learning techniques, which integrate visual, kinaesthetic, and interactive components to reinforce memory (Mustafa Che Omar et al., 2015).

Retention rates among students who engaged with the digital learning tools increased by 62%, as demonstrated by repeated post-assessments. In contrast, the control group, which relied solely on traditional textbooks and static instruction, exhibited a 20% lower retention rate. This suggests that digital learning, particularly for deaf and mute students, facilitates long-term recall by leveraging interactive and tactile methodologies. Given that deaf students rely primarily on visual and kinaesthetic cues to process new information, these findings underscore the necessity of alternative teaching strategies that go beyond conventional auditory-based methods (Norlidah Alias et al., 2022).

Further analysis showed that students who used the application demonstrated improved phonological awareness despite their hearing impairments. By associating each *Hijaiyyah* letter with visual cues and sign language animations, students developed a stronger recognition of letter shapes and their corresponding articulation points. These findings align with research by Liñan-Espinoza & Andrade-Arenas (2024), which highlights the importance of digital tools in creating multimodal learning experiences for deaf students.

Additionally, tactile engagement through the training kit further reinforced learning outcomes. Students who physically traced *Hijaiyyah* letters using embossed flashcards and interactive touchscreens exhibited a 30% higher accuracy in letter formation compared to those who only relied on visual exposure. These results confirm the effectiveness of kinaesthetic learning techniques, as supported by previous studies on special education technology (Elmahmoudi et al., 2021).

The combination of digital and physical learning resources played a crucial role in enhancing memory retention. Post-intervention interviews with students revealed that 83% of them found the interactive exercises more engaging and easier to recall compared to traditional rote memorisation techniques. Furthermore, teachers reported that students exhibited greater confidence and independence in recognising and practicing *Hijaiyyah* letters, indicating that technology-enhanced learning fosters long-term educational benefits in Quranic literacy for special needs students.

Effectiveness of Interactive and Gamified Learning Approaches

One of the most notable aspects of the mobile application was the integration of interactive and gamified learning

modules, which played a crucial role in maintaining student engagement. These modules featured real-time quizzes, animated sign language demonstrations, and point-based reward systems, making the learning process dynamic and immersive.

Student surveys revealed that 92% of participants favoured the gamified approach, citing its ability to make learning fun, engaging, and easier to understand compared to static classroom instruction. The use of visual representations alongside sign language animations further contributed to the effectiveness of the application. Educators noted that students displayed heightened levels of concentration and enthusiasm when engaging with the interactive modules. According to Shoba S. et al. (2024), the implementation of visualised real-time feedback mechanisms in educational applications enhances comprehension and motivation, particularly for students with sensory impairments.

The effectiveness of gamified learning is further supported by its ability to cater to different learning paces, allowing students to revisit lessons, practice repeatedly, and track their progress independently. This self-paced learning feature is essential for special needs education, as it allows students to grasp concepts at their own comfort level without feeling pressured or left behind (Mustaffar Abd Majid & Nor ‘Azah Ahmad Safran, 2017).

Additionally, students who engaged in competitive learning elements, such as leaderboards and achievement badges, demonstrated a 40% increase in motivation compared to those using non-gamified methods. This aligns with research by Llamazares de Prado (2021), which emphasises the role of gamification in improving student engagement and performance in digital learning environments.

Furthermore, the incorporation of adaptive difficulty levels within the interactive modules ensured that students were continuously challenged at an appropriate level. According to Siong et al. (2021), personalised digital learning pathways improve retention and comprehension for students with hearing impairments by adjusting content difficulty based on real-time performance feedback. This personalised learning approach ensures that students remain engaged while progressing at their own pace.

Teachers also highlighted the positive impact of gamification in fostering collaborative learning. Group-based activities, such as peer challenges and interactive storytelling modules, encouraged teamwork and communication among students, creating a more inclusive and engaging classroom environment. These findings reinforce the argument that technology-enhanced gamification can bridge learning gaps and provide meaningful educational experiences for special needs students.

Teacher Perspectives and Challenges in Implementation

Teachers who participated in the study generally expressed positive feedback regarding the usability and effectiveness of the mobile application. 78% of educators observed increased engagement levels among students and noted a more proactive approach to learning *Hijaiyyah* letters. However, several challenges in implementation were identified, highlighting the need for continuous teacher support and infrastructure development.

One of the key challenges was technical literacy among educators. 43% of teachers initially encountered difficulties navigating the mobile application, as many were unfamiliar with digital teaching tools. This underscores the importance of comprehensive teacher training programs to equip educators with the necessary digital competencies. Additionally, 57% of teachers recommended additional workshops to enhance their ability to integrate assistive technology effectively into their teaching methods (Muhammad Sayuti Sabdan et al., 2022).

Infrastructure limitations also posed a significant challenge. Some schools lacked adequate devices and stable internet connectivity, which hindered the seamless implementation of the mobile application. While the application was designed to function offline, real-time updates and interactive features required occasional internet access, which was unavailable in certain rural areas. This finding suggests that future implementations should consider developing offline-first applications that allow full functionality without internet dependence (Nasir & Afendi, 2016).

Furthermore, 65% of teachers reported a need for additional technical support to troubleshoot software-related

issues. Establishing dedicated technical assistance teams in schools could ensure smoother integration of digital learning tools. Additionally, policymakers should prioritise infrastructure improvements, such as equipping schools with updated digital resources and providing financial aid for assistive technology adoption. Future research should explore the long-term impact of teacher training programs on the sustainability of technology-driven special education initiatives.

Student Motivation and Learning Experience

A key outcome of the study was the notable increase in student motivation and enthusiasm toward learning Hijaiyyah letters. Student feedback collected through structured interviews and surveys indicated that 88% of students found the digital learning approach more engaging compared to traditional methods. Furthermore, 79% of students expressed greater confidence in their ability to recognise and recall Hijaiyyah letters, which highlights the motivational impact of interactive and tactile-based learning.

The training kit's tactile learning components, such as embossed flashcards and sensory-based exercises, proved especially beneficial for kinaesthetic learners. These tools allowed students to physically trace the shapes of *Hijaiyyah* letters, reinforcing letter recognition through touch and movement. The study reaffirms previous findings that kinaesthetic learning is highly effective for students with sensory impairments, as it helps bridge the gap between visual recognition and cognitive retention (Norlidah Alias et al., 2022).

Furthermore, the integration of gamification elements within the mobile application, such as point-based rewards, interactive storytelling, and digital badges, significantly contributed to sustaining student interest. A study by Nur Syarafina Binti Abdul Rahman et al. (2020) found that students using gamified learning tools demonstrated higher levels of motivation and retention compared to those in conventional learning settings. This finding aligns with the current study, where 91% of students expressed that the competitive and reward-based features motivated them to engage more actively with the lessons.

Another key factor contributing to enhanced motivation was the ability of students to learn at their own pace. The mobile application provided personalised learning pathways that adjusted based on student progress, ensuring that each learner received an optimised experience. This approach is supported by research from Liñan-Espinoza & Andrade-Arenas (2024), which highlights that adaptive learning systems improve student engagement by catering to individual learning styles.

Additionally, the use of interactive quizzes and real-time feedback mechanisms helped reinforce learning outcomes by allowing students to track their progress and identify areas for improvement. According to Shoba S. et al. (2024), real-time feedback in educational applications plays a crucial role in maintaining student engagement and motivation. These features enabled students to develop self-confidence in their ability to recognise and recall *Hijaiyyah* letters more effectively.

Overall, the findings indicate that incorporating interactive, tactile, and gamified learning approaches within digital education tools significantly enhances student motivation, engagement, and confidence. Future implementations should consider expanding these elements to further personalise learning experiences and sustain long-term interest in Quranic literacy among deaf and mute students.

Comparative Analysis: Technology-Based vs. Traditional Learning

When comparing the experimental group (technology-based learning) with the control group (traditional methods), several significant trends emerged. Students who used the mobile application and training kit demonstrated an 85% improvement in letter recognition, compared to only 55% progress among students in the traditional learning group. Moreover, the retention rate for the experimental group was 62% higher, demonstrating the long-term effectiveness of interactive and gamified learning strategies.

Furthermore, digital learning participants exhibited a 92% engagement rate, significantly surpassing the 64% engagement rate observed in traditional classrooms. These results reinforce the argument that assistive technology enhances engagement, comprehension, and motivation for special needs students. According to

Norlidah Alias et al. (2022), deaf students benefit from multimodal learning approaches that incorporate visual, interactive, and tactile elements, which supports the findings of this study.

Additionally, the study found that students in the experimental group demonstrated a 48% reduction in errors related to letter confusion, such as mistaking ح (Ha) for خ (Kha), compared to a 17% reduction in the control group. This suggests that the interactive features of the mobile application, including real-time feedback and corrective guidance, played a crucial role in helping students differentiate between similar letters. These findings align with research by Siong et al. (2021), which emphasises the importance of interactive learning environments for enhancing cognitive retention in special education.

Moreover, students in the experimental group exhibited higher levels of independent learning behaviour. Post-study surveys revealed that 87% of students using the mobile application felt confident practicing *Hijaiyyah* letters without teacher supervision, compared to only 49% in the control group. This aligns with findings by Liñan-Espinoza & Andrade-Arenas (2024), which highlight the role of digital self-learning tools in fostering autonomy among special needs learners.

Another notable finding was the difference in teacher-student interaction dynamics. In the experimental group, 71% of teachers reported a shift from direct instruction to facilitation, where students actively engaged with the mobile application while teachers provided targeted support when needed. This contrasts with the control group, where 89% of teachers relied on traditional direct instruction methods. These findings support previous studies that advocate for student-centred learning approaches in special education (Elmahmoudi et al., 2021).

Overall, the comparative analysis confirms that the integration of technology in Quranic literacy education for deaf and mute students offers significant advantages over traditional learning methods. Future research should explore the long-term effects of sustained technology use on literacy development and assess how further advancements, such as AI-driven learning pathways, could enhance student learning outcomes.

Challenges and Future Recommendations

While the study highlights the effectiveness of digital learning tools, certain areas require further improvement. One recommendation is the customisation of learning pathways based on individual student proficiency levels. Currently, the mobile application follows a fixed curriculum structure, but integrating AI-driven adaptive learning systems could provide personalised lesson plans that adjust according to student progress. Additionally, the expansion of cloud-based accessibility could enable remote learning capabilities, ensuring that students from underprivileged backgrounds also benefit from these technological advancements.

Another key challenge identified was the lack of teacher training in utilising digital tools effectively. Although most educators acknowledged the benefits of the mobile application, 43% reported difficulties in integrating it into their teaching routines. To address this, continuous professional development programs should be established to equip teachers with the necessary digital literacy skills. Research by Muhammad Sayuti Sabdan et al. (2022) supports the need for structured training initiatives to enhance educators' competency in special needs digital education.

Infrastructure limitations, particularly in rural and underprivileged schools, remain a significant barrier to the widespread adoption of assistive technology. Some institutions lack adequate funding to procure the necessary digital devices, and unstable internet connectivity further complicates implementation. According to Nasir & Afendi (2016), the development of offline-accessible mobile applications can bridge this gap by allowing students to engage with interactive content without relying on continuous internet access.

Future research should also explore the integration of multimodal learning technologies, such as augmented reality (AR) and haptic feedback systems, to enhance the tactile learning experience for deaf and mute students. Studies by Elmahmoudi et al. (2021) indicate that incorporating AR-based sign language instruction can improve comprehension and engagement levels among special needs learners.

Additionally, collaboration with policymakers and educational institutions is crucial for scaling up digital

learning solutions in Islamic special education. Government-backed initiatives should focus on providing financial aid, infrastructure development, and policy frameworks to support the integration of technology in Quranic literacy programs. Research by Liñan-Espinoza & Andrade-Arenas (2024) emphasises the importance of institutional support in fostering sustainable and inclusive digital learning environments.

By addressing these challenges and implementing strategic improvements, digital learning tools can be further optimised to enhance the educational outcomes of deaf and mute students. The ongoing development of innovative assistive technologies will play a critical role in ensuring greater accessibility, inclusivity, and effectiveness in special education curricula.

CONCLUSION AND RECOMMENDATIONS

This study confirms that the integration of mobile applications and interactive training kits significantly enhances *Hijaiyyah* letter learning among deaf and mute students. The findings highlight notable improvements in letter recognition, retention, and student engagement, with interactive and gamified learning proving particularly effective. However, certain challenges, such as teacher readiness, infrastructure limitations, and technological adaptation, must be addressed for broader implementation.

To enhance the long-term impact of this approach, several recommendations are proposed. Firstly, future applications should incorporate AI to personalise learning pathways based on student progress. For example, AI-Driven Adaptive Learning can enable real-time adjustments to lesson difficulty, ensuring that each student learns at an optimal pace. Secondly, comprehensive teacher training programs should be conducted to equip educators with the necessary digital teaching skills. These programs should include hands-on workshops, continuous professional development, and peer-learning opportunities to ensure educators are well-prepared to integrate technology into special education.

Additionally, enhancing offline accessibility ensures greater usability in areas with limited internet connectivity. Future iterations of the mobile application should include robust offline features, such as preloaded lesson modules and interactive exercises, to provide uninterrupted learning experiences regardless of connectivity constraints. Furthermore, expanding the training kit with more tactile learning tools, such as embossed letter guides and haptic feedback devices, could further support kinaesthetic learning for deaf and mute students.

Collaboration with policymakers and educational institutions is crucial to facilitate the widespread adoption of digital learning tools in Islamic special education. Government and institutional support should focus on funding technological advancements, improving infrastructure, and standardising digital Quranic education curricula for special needs students.

By addressing these challenges and leveraging technological advancements, this study contributes to the broader field of Islamic special education and assistive learning, providing a scalable model for enhancing Quranic literacy through digital innovation. Future research should explore the long-term effects of digital interventions on special needs education and investigate additional assistive technologies that could further improve learning outcomes for deaf and mute students.

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Paper Contribution to The Related Field of Study

This paper is believed to contribute new knowledge, especially in the use of new media, which coincides with the Malaysian government's efforts to improve the Malaysian People's Well-Being Index (Indeks Kesejahteraan

Rakyat Malaysia) and the Religious Harmony Index contained in the Wawasan Kemakmuran Bersama (2030) in line with the Sustainable Development Goals and the Manhaj Rabbani Policy for realizing the goal of a United, Prosperous, and Dignified Nation. Hopefully, the increase in new media users will be led by the perfection of Islamic morals.

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