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Improving the Quality of Life for Autistic Children through Mobile-Based Learning and Developmental Monitoring

Luqman Hidayat[1]*, Laeli Nur Hasanah[2], Rianto[3]

[1] *Department of Special Education, Faculty of Teacher Training and Education, Universitas PGRI Yogyakarta, Yogyakarta, Indonesia, luqman@upy.ac.id, ORCID: https://orcid.org/0000-0001-7964-6004*
[2] *Department of Nutrition, Faculty of Science & Technology, Universitas PGRI Yogyakarta, Yogyakarta, Indonesia, laeli@upy.ac.id, ORCID: https://orcid.org/0000-0002-4939-3525*
[3] *Department of Information System, Faculty of Science & Technology, Universitas PGRI Yogyakarta, Yogyakarta, Indonesia, rianto@upy.ac.id, ORCHID: https://orcid.org/0000-0002-4551-1686*

*__Corresponding Author:__ luqman@upy.ac.id

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ABSTRACT

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder with increasing prevalence worldwide. This disorder significantly impacts not only children diagnosed with ASD but also their families, posing challenges in daily life, education, and social integration. Digital support technology, especially mobile applications, has emerged as a valuable tool for providing comprehensive support to children with autism and their families, ultimately enhancing the quality of life for children with autism. This study aims to develop and evaluate the effectiveness of mobile applications in enhancing the development of children with autism, particularly in gross motor skills, fine motor skills, communication skills, problem-solving abilities, and social skills. This research adopted the ADDIE model framework, comprising Analysis (A), Design (D), Development (D), Implementation (I), and Evaluation (E). An interactive mobile application was developed to address the specific educational and developmental needs of children with autism. The effectiveness of the application was evaluated using Welch's test. The study resulted in the development of the AutiParent mobile application, which integrates various features, including health services, educational modules, social support, child profiles, health screening and monitoring, social skills training, educational games, communication tools, structured schedule recording, and community interaction support. The application's effectiveness was tested over five months, revealing a statistically significant improvement in children's developmental skills across all tested areas. Statistical analysis using Welch's t-test demonstrated a p-value <0.05 for all indicators, confirming a significant difference between the first and fifth months. The consistently higher average scores in the fifth month indicate significant improvements in all assessed developmental aspects. This study provides empirical evidence supporting the use of digital interventions to enhance the developmental skills and quality of life of children with ASD and their families. The findings highlight the potential of mobile applications as accessible, cost-effective, and personalized tools for structured learning and developmental monitoring.

Keywords: Autism Spectrum Disorder, Mobile Application, Educational Interventions, Cognitive Development, Social Development

INTRODUCTION

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder characterized by deficits in social communication as well as restricted and repetitive patterns of behavior, interests, and activities. According to the American Psychiatric Association, the global prevalence of ASD continues to increase, with an estimated 1% of

the world's population affected (Hashim et al., 2022; Moon et al., 2020). In some countries, such as the United States, the prevalence of ASD is as high as 1 in every 59 children (Al-Rashaida et al., 2022; Gallardo-Montes et al., 2022). This underscores the urgent need for widely accessible educational and therapeutic interventions to support the development of children with ASD.

Digital technology, particularly mobile apps, has become one of the innovative solutions for supporting education and intervention for children with ASD (Bonnot et al., 2021; Stathopoulou et al., 2020). The app offers various advantages, such as flexibility, accessibility, and the ability to customize content according to user needs (Hashim et al., 2022; Penev et al., 2021; Sanromà-Giménez et al., 2021). In addition, the app enables use in home and community environments, making it an inclusive and cost-effective tool (Dubey et al., 2024; Stathopoulou et al., 2020). Previous studies have shown that mobile apps can improve the social, communication, and cognitive skills of children with ASD through multimedia-based and interactive approaches (Gallardo-Montes et al., 2022; Purnama et al., 2021; Stathopoulou et al., 2020).

However, most existing apps have not gone through a rigorous scientific evaluation process to ensure their effectiveness (Moon et al., 2020; Sanromà-Giménez et al., 2021). In an educational context, the evaluation and development of digital tools for students with ASD is crucial to ensure that the technology can meet their specific needs in a pedagogical and inclusive manner (Al-Saadi & Al-Thani, 2023; Gallardo-Montes et al., 2022; Sanromà-Giménez et al., 2021). One promising approach is the use of augmented reality (AR), which has been shown to provide a more relevant and meaningful learning experience (Al-Saadi & Al-Thani, 2023; Liu et al., 2023).

While there have been many studies exploring the potential of mobile apps in supporting ASD interventions, there are still gaps in the development and implementation of these technologies in resource-limited countries (Bonnot et al., 2021; Dubey et al., 2024; Umiera Hashim et al., 2021). Therefore, this study aims to evaluate the effectiveness of mobile apps in supporting children with ASD, focusing on aspects of inclusivity, user engagement, and impact on social and cognitive development.

METHODS

This study utilized the ADDIE model design, which consists of Analysis (A), Design (D), Development (D), Implementation (I), and Evaluation (E). It was conducted in Yogyakarta, Indonesia, and involved participants from families with children with autism.

Needs Analysis Stage

This stage has been conducted to measure the needs of the planned software to support the education and health status of children with autism. Data was collected through literature study, observation, and interviews with families of children with autism, special education teachers, health workers, psychologists, and therapists.

Design Stage

The design was carried out to create an application concept that would be used with a focus on the integration features of the health, education, and social support indicators. Design activities include sketching, visual design, and initial mockup stages. The main features include health modules, education modules, educational games, communication aids, and community interaction support. This design aims to provide alternative solutions in a holistic manner involving experts.

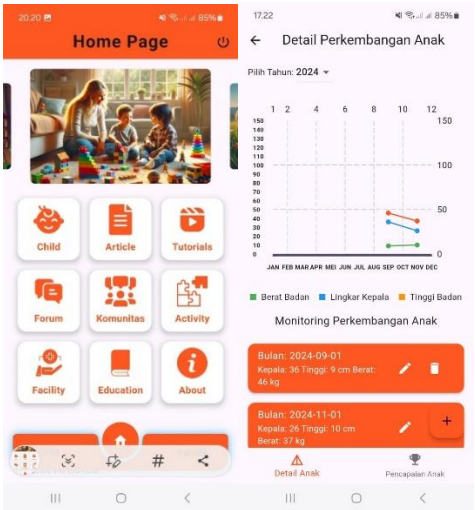

Figure 1. Home Page and Child Development

Development Stage

The development phase of the interactive application has been developed as planned to test the level of basic functionality and navigation. The app was tested by a team of experts consisting of parents, teachers, health workers, and the autism community. Criticisms and suggestions from the expert team were used to refine and improve the application until it was suitable for user testing.

Implementation Stage

The implementation test phase was conducted on 46 potential users, namely families with children with autism. The assessment was conducted using a questionnaire to evaluate the functionality, usability, performance, and user satisfaction tests. Data analysis used a T-test to measure and interpret data related to application feasibility to users. The data from the pilot test was used to improve the application where there are 15 indicators to assess the level of health and education. Potential user inclusion criteria, namely:

- Have a child with autism aged 2-11 years old
- The user can use Android
- User is willing to volunteer
- Users register themselves in the application

Table 1. Assessment Indicators of Autistic Child Application

No	Assessment Indicators
1	**Gross Motor Skills**
	Child's ability to walk
	The child's ability to jump
	Ability to walk throw
2	**Fine Motor Skills**
	Cutting out simple shapes
	Drawing simple shapes
	Stringing beads
3	**Communication Skills**
	Can ask for help with words or gestures
	Can understand simple instructions
	Can interact with others
4	**Problem Solving Ability**
	Can arrange blocks in a certain shape
	Can complete games such as the exit in a maze
	Can complete simple puzzles
5	**Social Skills**
	Can take turns playing
	Can share with friends
	Embraces friends

Evaluation Stage

The evaluation stage has been done to improve and correct the shortcomings related to the design and functionality of the application during the implementation stage.

RESULTS AND DISCUSSION

This research has resulted in the Autiparent application, which aims to support the education and health of children with ASD. The application design contains health services, education and social support features such as child profiles, health screening and monitoring, education modules, autism child health modules, social skills modules, educational games, communication tools, structured schedule recording, and community support and social interaction.

The results of the Autiparent application implementation test are presented in Table 2.

Table 2. Descriptive statistics from the results of the Welch's test

Assessment Indicators	Mean		Standard Deviation		P-value (Sig.)
	First Month	Fifth Month	First Month	Fifth Month	
Child's ability to walk	1.6957	2.8478	0.46522	0.36316	0.000
The child's ability to jump	2.0000	2.4783	0.89443	0.65791	0.000
Ability to walk throw	1.7174	2.3696	0.80727	0.67852	0.000
Cutting out simple shapes	1.6739	2.2609	0.99005	0.82825	0.000
Drawing simple shapes	1.5217	2.2609	0.80937	0.74341	0.000
Stringing beads	1.4565	2.0435	1.10969	0.91788	0.000
Can ask for help with words or gestures	1.6304	2.4378	0.77053	0.70608	0.000
Can understand simple instructions	1.5652	2.1957	0.91049	0.74891	0.000
Can interact with others	1.8913	2.4783	0.90008	0.69087	0.000
Can arrange blocks in a certain shape	1.6304	2.3696	0.67852	0.64494	0.000
Can complete games such as the exit in a maze	1.5000	2.2609	0.78174	0.68101	0.000
Can complete simple puzzles	1.3478	2.1522	0.73688	0.66558	0.000
Can take turns playing	1.7174	2.4783	0.80727	0.65791	0.000
Can share with friends	1.5435	2.3261	0.68982	0.70093	0.000
Embraces friends	1.3043	1.9130	0.75629	0.58977	0.000

(Source: Authors)

Table 2 is the result of Welch's t-test to measure the effectiveness of the development of autistic children using the "AutiParent" application. Respondents numbered 46 people whose data were taken in the first and fifth months. In the data analysis, 15 statements were found that were used to measure the level of effectiveness of the autistic child application from potential users. The results of the study stated that the assessment indicators had a significant p-value. This shows that the p-value is less than 0.05. All indicators have a p-value = 0.000, which means that the difference between the first and fifth months is very significant. The average scores in the fifth month were consistently higher than those in the first month, confirming significant improvements across all tested developmental aspects. Several indicators with large increases such as walking ability (1.6957 → 2.8478), social interaction (1.8913 → 2.4783), sharing with friends (1.5435 → 2.3261), Can arrange blocks according to certain shapes (1.6304 → 2.4378). This increase shows that children have made progress in motor, social, and cognitive skills after five months of training. This shows that there is a statistically significant change, where there is a real difference between the data from the first month and the fifth month.

Previous studies have also found that there is an increased level of mental health in parents of children with autism, with a significant reduction in anxiety and an improvement in overall quality of life (Zhao et al., 2021). Then, another study tested a telehealth program with a stepped-care basis for parents of children with ASD. Research has suggested that digital interventions, such as reciprocal imitation training (RIT), are well received by parents and effective in improving the skills of children with ASD (Wainer et al., 2021). Moreover, the results of these studies can also support the results of this study regarding the implementation of mobile applications for parents of children with autism to improve the health and education status of their children.

In addition, other study results show that VR technology can improve social skills, communication, and self-understanding in children with ASD, and this can open up opportunities for new therapies (Zhang et al., 2022). This study also has indicators regarding communication, problem-solving, and social skills in children with autism where there are statistically significant results stating that this mobile application can help to improve communication, social, and problem-solving solving which is in line with previous studies.

Furthermore, there are research findings that identify that there are two types of interventions that can provide a positive outcome to improve social skills, communication, and behavior in children with ASD (K. Sagayaraj et al., 2020). Other research has also suggested that smart technology products that support collaboration can improve the social and interaction skills of children with ASD(Cañete & Peralta, 2022). The results of these studies can also support the relevance of the results of this study to improve the degree of social skills of children with autism.

Furthermore, previous research has also emphasized the importance of accessing social support and remote health services to reduce the negative impact on the well-being of individuals with autism and their families (Ameis et al., 2020). In addition, the application of technology-based systems can support the development of social and behavioral skills of children with ASD where these technologies show a positive impact on improving social interactions and reducing ASD symptoms (Hadiloo & Heydari, 2023). Barriers to care for children with autism are often caused by a confusing referral process (Habayeb et al., 2023). Because of this, it is possible to have an integrated correlation to facilitate parents of autistic children with technological needs such as this study application.

The relevance of this study is also supported by research on the use of web-based technology where which can increase the effectiveness of learning for children with autism (Yahya et al., 2023). Furthermore, this platform can assist in the development of cognitive skills of autistic children with a more personalized and effective approach (Chistol et al., 2023). Parents' active participation in the education process greatly influences the development of

children with autism (Chaidi & Drigas, 2020). Furthermore, the use of technological tools can accelerate a child's learning and therapeutic process, with a positive impact on their social and communication skills (Cuesta-Gómez et al., 2022), such as the mobile application for children with autism in this study.

Although this study shows that the AutiParent application can improve the development of children with autism, some limitations need to be considered. First, the sample size used in this study was relatively small and limited to a single region, so the results may not fully represent the broader population. Second, the study only evaluated the effectiveness of the application over five months, so the long-term impact is still unknown. Third, effectiveness measurement methods rely primarily on parent and caregiver reports, which can lead to subjective bias in child development assessments. In addition, external factors such as family environment and access to adjunct therapies are not strictly controlled, which can affect the results of the study. Therefore, further research with larger sample sizes, longer evaluation periods, as well as more objective measurement methods is needed to obtain a more comprehensive understanding of the effectiveness of these applications in supporting the development of children with autism.

CONCLUSION AND FUTURE SCOPE

This study confirms the effectiveness of the AutiParent mobile application in enhancing the developmental skills and quality of life of children with Autism Spectrum Disorder (ASD) and their families through structured learning and developmental monitoring.

For future research, several aspects need further exploration. First, long-term studies should be conducted to assess the sustained impact of mobile-based interventions on autistic children's development. Second, integrating artificial intelligence (AI) and machine learning could enhance personalization and adaptive learning experiences. Third, collaboration with healthcare providers and educational institutions could improve the scalability and accessibility of such applications across different socio-economic and cultural contexts. Finally, future research should explore the usability and effectiveness of mobile applications for ASD in real-world settings, particularly in low-resource environments where access to specialized services remains limited.

Ethical Statement

This research has obtained ethical approval from the Health Research Ethics Committee of Universitas Muhammadiyah Purwokerto (KEPK-UMP) with the registration number KEPK/UMP/33/XI/2024.

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