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Gamifying Number Recognition: A Mobile Learning Approach for Primary Students

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ABSTRACT

The rapid evolution of educational technology has led to the increased adoption of mobile learning (M-learning) as a tool to enhance teaching and learning. This study investigates the development and evaluation of "Kenali Nombor Asas", a mobile learning application designed to assist young learners, particularly primary school students, in recognizing and understanding basic numbers (0–9). Despite the growing integration of digital learning tools, students continue to face difficulties in numeracy acquisition, which can hinder their overall mathematical competency. The study aims to address this gap by developing an interactive mobile application that incorporates behavioral learning principles to reinforce number recognition skills through structured exercises and gamified learning experiences. The research employs the ADDIE instructional design model, ensuring a systematic approach to app development, from analysis and design to implementation and evaluation. Data were collected from a small cohort of primary school students using a questionnaire-based perception survey featuring a smileyometer scale and interviews with teachers. Findings indicate that students responded positively to the application, with all participants stating that the app was engaging, easy to use, and beneficial in learning mathematics. The analysis of student and teacher feedback revealed three key themes that reflect both the strengths and areas for improvement of the application: (i) increased engagement and motivation, (ii) ease of use and accessibility, and (iii) need for navigation and content enhancements. However, areas for improvement were identified, particularly in navigation and content accessibility. Based on these insights, recommendations include refining the app's user interface, incorporating adaptive learning features, and expanding its application to a broader demographic. In conclusion, this study demonstrates the potential of mobile learning applications in supporting early mathematics education, emphasizing the need for further research involving larger sample sizes and more rigorous performance assessments to validate its effectiveness.

1. Introduction

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The global education system has experienced an evolution in education technology when mobile learning or Mobile Learning (M-Learning) has been introduced and used widely to improve the level of teaching and learning. Because of that, the use of technology platforms such as Google Classroom, Microsoft Teams, SeeSaw, and other digital applications has become a digital teaching and learning medium, especially at a time when the world is hit by a pandemic. Mobile learning is the use of wireless devices that allow learning to happen anytime and anywhere [1]. In addition, mobile learning is also described as a learning process that takes advantage of mobile devices, ubiquitous communication technology, and smart user interfaces [2].

Although there are limitations and challenges in the use of smartphones or tablets in school, they can be used as alternative initiatives [3] and used informally outside of school hours to convey the content of the lesson to the target group while overcoming problems with internet access [4]. Globally, only 33 percent of children and young people have internet access at home. Statistics released by the Malaysian Securities Commission in 2019, 80% or 25.84 million of the population in Malaysia have internet access through smartphones and 78% of them actively use social media. The proof is that the highest percentage is the use of YouTube 93%, WhatsApp and Facebook 91%, and Instagram 70%. With that, mobile learning can enable independent learning to occur regardless of geographical factors and following the context [5].

However, the availability of mobile learning does not guarantee that it will be accepted by users or students as a tool to support their learning. Despite its strong penetration into the education system, there is no guarantee that it will be accepted as a learning medium by users or students. The understanding of the use of mobile technology in the educational environment is still in its infancy [3]. This highlights the necessity of assessing students' perceptions of mobile applications designed for educational purposes, particularly in subjects like mathematics. However, it requires thoughtful integration into teaching practices [6]. This is echoed by Shahrol *et al*., [7], who found that teachers' acceptance of mobile technology is crucial for creating meaningful learning experiences for students. Even with continuous developments in digital learning, there is still a clear gap in programs, especially to solve simple number recognition issues for Malaysian primary students. Existing tools fall short in real-world classrooms since most of the mobile applications do not match local curricular standards and cultural settings. Therefore, this study aims to explore students' perceptions of a mobile application explicitly created to support basic number recognition skills (0–9) among Malaysian primary school students. By focusing on local requirements and user feedback, this research seeks to shed light on how a more targeted, context-relevant mobile learning solution can be developed and adopted successfully.

2. Study Background

Mathematics is one of the subjects that is important for primary school students to learn because it helps in doing daily life affairs, starting from the smallest operations to problems involving specific formulas and formulas. The biggest challenge in mathematics education is the lack of awareness of the development of children's mathematics learning. This lack of awareness will continue in the students' learning, resulting in increasing frustration and experiencing inefficiency in mathematics skills among children [8]. With that, the importance of mastering mathematics is not only emphasized for mainstream students but also needs to be given attention to Special Education students. For example, the special education curriculum aims to build students' understanding of number concepts, basic calculation skills, and understanding simple Mathematical ideas. Therefore, learning and mastering the numbers 0 to 9 is an important element that is mandatory for every student whether in mainstream or special education [9].

The study was conducted by Feez [10] using existing materials, namely sandpaper number cards to help four students recognize basic numbers in a school in Negeri Sembilan. It is reported that the method can effectively improve students' basic number recognition skills. As a result, Ismail and Mohd Yasin [11] have modified Feez's method [10] with "SOBATAKA" to help three students with learning problems in recognizing basic numbers. The findings of the study show that "SOBATAKA" can improve the skills of recognizing and writing basic numbers while attracting students' interest in learning mathematics. Based on the studies discussed, it can be found that students' basic number learning is helped and improved with concrete materials. Therefore, this study focuses on a project that built a mobile application called "*Kenali Nombor Asas*" to help students learn these mathematical skills. In this project, the teacher has planned the teaching content based on the diagnostic tests that have been conducted on the students. The diagnostic test consists of ten questions related to focused skills and each question carries a weighting of 10 marks. Through the test, teachers have used various techniques or skills to help students recognize and recognize numbers taught based on objects. Students in the early stages usually count by rote without understanding. For example, children sing "One, two, three, four, whoever gets it first". However, it is possible that they have not yet understood the basic number concept well. Table 1 shows the diagnostic test scores obtained by five students in learning basic numbers.

Table 1
The diagnostic test scores obtained

Student	Diagnostic Test Scores
Student A	40%
Student B	30%
Student C	40%
Student D	30%
Student E	30%

As stated by Kankok *et al*., [3], the use of mobile technology in the educational environment is still in its infancy. Therefore, Grant [12] and Shorfuzzaman *et al*., [13] also stated that although many studies on mobile learning have been done, the underlying theory is still immature. Although the potential of mobile learning to enhance academic achievement has been supported by various studies. For example, Nuraini *et al*., [14] highlights that multimedia mobile applications can significantly improve the academic performance of elementary school students in physical education classes, suggesting that similar applications could be beneficial in mathematics education as well. This aligns with findings from Andriah and Amir, who assert that mobile learning can positively impact students' learning processes and outcomes in mathematics, specifically in understanding fractions [15]. Therefore, it is hoped to fill the knowledge gap that the lack of mobile learning applications for basic number recognition skills in the Malaysian context and aim to achieve the following objective: (i) develop a mobile learning application to help primary school students recognize the basic numbers which are the numbers 0 to 9; (ii) improve their basic number skills which are the numbers 0 to 9 through the exercises provided in the mobile learning application.

3. Literature Review

3.1. Learning Theory

Behaviorism theory sees learning and education as a change in an individual's behavior and throughout the process, it involves some exploration, trial, and error until a positive event occurs.

Behaviorists do not pay attention to what happens inside the student because according to their view, what happens inside is not available for direct observation [16]. This theory emphasizes that student participation is a stimulus-response process, largely passive and that knowledge is seen as factual, specific, and rigid. Next, Skinner [17] outlined four important points about learning. The first is that each step in the learning process should be simple and continuous from the behavior learned before. Second, for the learning process to be effective, students should be rewarded and reinforced consistently, at least in the early stages until the behavior is shaped by the pattern of reinforcement in the environment. Third, immediate feedback should be provided to students. Finally, students should be given 'stimulus discrimination' for the most likely path to success [17].

To that, learning has a strong connection to changing a person's behavior. Learning is a relatively permanent change in potential behavior resulting from experience [18]. Behaviorism in its context aims to produce behavioral changes in the desired direction. As such, this theory can be used in today's educational environment and is widely used by educators during the teaching and learning process. Mobile learning applications can effectively incorporate behaviorist principles by providing immediate feedback and reinforcement to students as they engage with mathematical tasks. For example, Sung *et al*., [19] highlight that mobile-computer-supported collaborative learning can enhance peer interaction and problem-solving skills, which are essential for subjects like mathematics. This collaborative approach aligns with behaviorist strategies, as students can receive immediate feedback from peers and the application itself, reinforcing correct responses and guiding them through incorrect ones.

Additionally, the findings of Gözüm and Demır [20] indicate that mobile learning environments can help develop metacognitive skills, which are essential for effective learning. By fostering metacognitive awareness, mobile applications can encourage students to reflect on their learning processes, thereby enhancing their ability to self-regulate their learning behaviors, a key aspect of behaviorist learning theories. Therefore, in this mobile learning application, behaviorism theory was used. Training activities such as matching answers based on diagrams and quizzes have been prepared to strengthen the understanding and skills learned by students. Pupils will be given positive reinforcement if they answer the questions correctly and can also do exercises repeatedly until they master and understand the basic numbers which are the numbers 0 to 9 through this mobile learning application.

3.2. Related Studies

The integration of mobile learning applications in mathematics education, particularly for teaching basic number recognition (0-9) in primary school, has been the subject of various studies that highlight its effectiveness in enhancing learning outcomes. These studies provide a foundation for understanding how mobile technology can be leveraged to improve mathematical skills among young learners. One significant study by Hakim [21] discusses the impact of mobile learning on elementary students' mathematics learning processes and outcomes. The study indicates that when mobile learning is wisely applied, it can lead to improved understanding and retention of mathematical concepts among primary school students. This finding is crucial, as it suggests that mobile applications can effectively support the learning of basic numbers, which is foundational for further mathematical learning.

Nashrullah *et al*., [22] also contributes to this discourse by examining the role of mobile learning in developing students' critical thinking abilities in mathematics. The study found that students who engaged with mobile learning in a realistic mathematics education context demonstrated higher critical thinking skills compared to those who did not. This is particularly relevant for number

recognition, as critical thinking is essential for understanding numerical relationships and problem-solving. Moreover, the systematic review conducted by Dũng *et al*., [23] highlights the growing prevalence of mobile devices in education and their potential to enhance mathematics learning. The review indicates that mobile learning offers flexibility, portability, and interactivity, which are beneficial for engaging students in mathematical tasks, including basic number recognition. This aligns with the notion that mobile learning can create a more dynamic and interactive learning environment for young learners. Arifin et al. further support the effectiveness of mobile learning by demonstrating that interactive mobile mathematics inquiry can enhance students' problem-solving skills [24]. This is particularly important for teaching basic numbers, as problem-solving skills are often developed through practice and application of numerical concepts in various contexts. In summary, the body of research indicates that mobile learning applications can significantly enhance the teaching and learning of basic number recognition in primary mathematics education. By providing interactive, flexible, and engaging learning experiences, mobile applications can support young learners in developing essential mathematical skills.

4. Methodology

This study employed a design and development research (DDR) approach, guided by the ADDIE instructional design model, to systematically develop and evaluate the "*Kenali Nombor Asas*" mobile learning application. The methodology was structured into five phases: (i) Analysis, where students' difficulties in recognizing numbers were identified through diagnostic assessments; (ii) Design, where interactive learning elements, gamification features, and user-friendly navigation were conceptualized; (iii) Development, where the application was built using MIT App Inventor with engaging visuals and interactive exercises; (iv) Implementation, where the app was tested with a group of five primary school students (N=5) from Year 1; and (v) Evaluation.

To test students' perception of this mobile application, a questionnaire was adapted from the study by Melin *et al*., [25]. This questionnaire instrument contains two main parts which are the respondent's background information and the user's perception of this application after it has been revealed. For part A, there are 2 items which are gender and age of the user. Meanwhile, there are as many as 10 items in part B which are the user's perception of the use of mobile applications in learning mathematics. The items used in part B of the questionnaire are listed in Table 2. The adaptation was conducted using the smileyometer scale to test the perception of primary school students in this study. The smileyometer scale is usually used in evaluating technology products with children because children understand more easily and give more accurate feedback than the Likert scale [26,27].

The study participants were selected through purposive sampling, targeting students who exhibited challenges in early numeracy. The data collection process involved both quantitative and qualitative methods: a questionnaire survey to assess usability, engagement, and effectiveness, and teacher observations to gather qualitative insights on student interactions with the app. The smileyometer scale was chosen for its simplicity and effectiveness in measuring young learners' responses, while open-ended teacher feedback provided deeper insights into the app's impact on student motivation and learning behaviors. Descriptive statistics, such as percentage distributions and frequency counts, were used to analyze survey responses, while qualitative comments were thematically analyzed to identify patterns in user experiences. To ensure the validity and reliability of the findings, the survey instrument was adapted from prior research on educational technology acceptance and reviewed by experienced educators. Ethical considerations were also observed, ensuring informed consent from parents and guardians before students participated in the study.

Table 2
The item of perception towards mobile learning application among students

Code	Item Description
PP1	It is a distraction.
PP2	It interferes with my learning activities.
PP3	It consumes too much of my time in learning mathematics.
PP4	An introduction on how to use the application is appropriate.
PP5	It is boring to use.
PP6	It is easy to use.
PP7	It is good to use.
PP8	The time spent using it is acceptable.
PP9	I would recommend it to my friends.
PP10	It is hard to remember to use it.

Note. Items adapted from Melin *et al*., [25]

5. Mobile Application Development and Design

5.1. ADDIE Model and Its Development Phases

The ADDIE model was used as an instructional design so that an orderly and systematic work process is implemented. Each stage of the work process in the ADDIE Model is easy to follow and implement. This model has five main stages, namely (i) analysis, (ii) design, (iii) development, (iv) implementation, and (v) evaluation. Figure 1 shows the phases of the mobile application development and design.

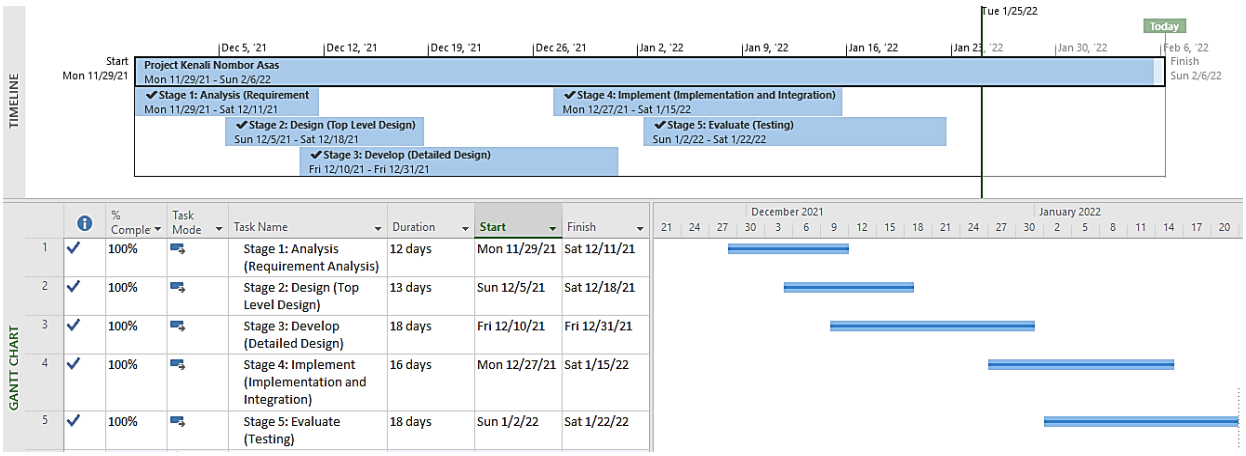

Fig. 2. The phases of the mobile application development and design

In the First Phase, which is the Analysis Phase, several analyses are carried out such as aspects of the learning environment analysis, user analysis, analysis of teaching and learning goals, and syllabus analysis. Diagnostic tests are also performed. The topic Recognize Basic Numbers for Year One Students' Mobile Learning has been set. The Second Phase is the Design Phase. At this stage, design, structure and navigation, teaching and learning approaches, learning theory, storyboards, media, and interactive types, as well as topic content have been proposed and discussed. In this final phase, the third phase is started simultaneously. The Third Phase is the Development Phase. A mobile learning application is developed based on the proposed design. This development process includes authoring, programming, graphics, audio, video, and so on. The Fourth Phase is the Implementation Phase. This mobile learning application is presented to test its effectiveness. Problems that arise inadvertently during the Design and Development Phase are resolved in this phase. Improvement and recovery steps are implemented in this phase before the application is officially distributed. In

the last phase, which is the Evaluation Phase, this mobile application is tested among the target group, namely Year One students under the supervision of subject teachers. A questionnaire was also administered electronically to collect feedback on the target's usage experience. This phase is important to identify the necessary improvements.

5.2. The Interfaces of Mobile Application

In this mobile application, there are three main modules: learning module, activity module, and training module. Each module is built based on learning theory to suit the way students learn in primary school. The visual interfaces of this mobile learning application are shown in Table 3. Each interface has been designed and developed using the online software MIT AppInventor and graphic materials downloaded for free from the digital platform Canva.

Table 3
The examples of visual interfaces of the mobile learning application

Visual Interfaces	Descriptions
	The note module interface shows how to write base ten numbers with the corresponding number of aliens. Students are allowed to click on each number to learn how to write and revise easily. The home icon will bring the application to the main menu.
	The training module allows students to try to match the number with the number of objects in the picture. If the match is correct, the red dot will disappear. A retry button is provided for students to practice repeatedly and the home icon will bring the application to the main menu.
	Quiz modules are provided for students to test their understanding. Students are asked to enter the correct basic number answer in the space provided and then click the check answer button. A feedback mechanism is added to respond. For example, the response “Congratulations! Your answer is correct and accurate!” will be displayed if the number entered is correct. A score of “1” for each correct question will appear at the top of the display. Students are asked to click the "next question" button to display the second quiz.

A total of four quiz questions are provided. If the student has answered all the questions correctly, "Your game is over!" will appear. A "Back" button will appear and will take students to the main menu if clicked.

6. Results

6.1. Quantitative Findings

The data of this study were collected through a questionnaire that was administered to the target students in the class and aimed to find out the students' perception of the mobile application that was introduced and used in learning mathematics. To support the results of this study, interviews were conducted to collect qualitative data from their teachers. This quantitative data was based on the perception of 5 students consisting of 2 males (40 %) and 3 females (60 %). Table 4 shows the quantitative data of the students' perception of the mobile learning application.

Table 4
The results of students' perception of mobile learning application

Item	Perception Agreement				
	SDA	**DA**	**SA**	**AA**	**SSA**
PP1	3 (60%)	2 (40%)	0 (0%)	0 (0%)	0 (0%)
PP2	3 (60%)	2 (40%)	0 (0%)	0 (0%)	0 (0%)
PP3	4 (80%)	1 (20%)	0 (0%)	0 (0%)	0 (0%)
PP4	0 (0%)	0 (0%)	0 (0%)	3 (60%)	2 (40%)
PP5	3 (60%)	2 (40%)	0 (0%)	0 (0%)	0 (0%)
PP6	0 (0%)	0 (0%)	0 (0%)	4 (80%)	1 (20%)
PP7	0 (0%)	0 (0%)	0 (0%)	3 (60%)	2 (40%)
PP8	0 (0%)	0 (0%)	0 (0%)	4 (80%)	1 (20%)
PP9	0 (0%)	0 (0%)	0 (0%)	4 (80%)	1 (20%)
PP10	0 (0%)	5 (100%)	0 (0%)	0 (0%)	0 (0%)

Note. SDA = Strong Disagree, DA = Disagree, SA = Slightly Agree, AA = Agree, SSA = Strong Agree

For item PP1 which is "It is a distraction", there were 3 students (60 %) responding that they disagreed and 2 students (40 %) stating that they strongly disagreed with the statement of the item. Therefore, all respondents thought that this mobile application did not become a distraction to them in class. For PP2, which is "It disturbs me in my learning activities", there was a total of 3 students (60 %) responding that they disagreed and 2 students (40 %) stating that they strongly disagreed with the statement of the item. So, all the students stated that this mobile application did not disturb them in their math learning activities. Next, this application was also found not to be too time-consuming for students learning mathematics in class. As many as 80% of people, namely 4 students, stated that they did not agree and 20%, which was one student, stated that he strongly disagreed with the statement of item PP3. As for item PP4, as many as 60% (3 students) agreed and 40% (2 students) strongly agreed that the introduction of how to use this mobile application was appropriate and helped them understand the use and navigation of the application in learning mathematics. As many as 60% (3 students) and 40% (2 students) expressed strong disagreement and disagreement

with the statement of item PP5 where this mobile application was boring for them to use in learning mathematics.

For item PP6, all participants thought that this mobile application was easy to use, which was 80% (4 students) and 20% (1 student) expressed strong agreement with the statement of item PP6. As for item PP7, all the students thought that this application was good to use in learning mathematics, which was as much as 60% (3 students) and 40% (2 students) expressed strong agreement and agreement with the statement of this item. For item PP8, 20% (1 student) and 80% (4 students) responded strongly, agreeing and agreeing that the time spent using this mobile application was appropriate and acceptable. Application usage time was important so that they could maintain focus when following math class. For item PP9, it was found that all students want to recommend mobile applications to their friends so that they can learn mathematics with fun and ease. A total of 80% (4 students) and 20% (1 student) expressed strong agreement and agreement with the statement of the item after the mobile application was introduced and used in class. For item PP10, 100% (5 students) stated that they did not agree that this mobile application was difficult to remember to use in learning mathematics.

6.2. Qualitative Findings

The qualitative findings of this study provide deeper insights into students' experiences and engagement with the "*Kenali Nombor Asas*" mobile learning application. Observations and open-ended feedback from students and teachers revealed that the interactive nature of the app significantly enhanced student engagement and motivation in learning mathematics. Through the analysis of students' and teachers' feedback, three key themes emerged regarding their experiences with the "*Kenali Nombor Asas*" mobile learning application: (i) increased engagement and motivation, (ii) ease of use and accessibility, and (iii) need for navigation and content enhancements. These themes highlight both the strengths and areas for improvement of the application.

6.2.1. Increased engagement and motivation

Students expressed higher engagement and motivation when using the mobile application compared to traditional worksheets. The interactive elements, such as animated numbers, sound effects, and gamified activities, helped maintain their interest in learning. One student mentioned, "*Saya suka aplikasi ini kerana saya boleh belajar nombor sambil bermain!"* (I love this app because I can learn numbers while playing!). Teachers also observed that students who typically struggled with number recognition in a traditional classroom setting were more eager to participate. A teacher stated, "*Murid lebih seronok menggunakan aplikasi ini kerana ia memberi maklum balas segera dan tidak membosankan seperti lembaran kerja."* (Students enjoy using this app because it provides instant feedback and is not as boring as worksheets).

6.2.2. Ease of use and accessibility

Most students and teachers found the application easy to use and navigate. The simple tap-and-learn interface allowed students to engage in number recognition activities without requiring extensive guidance. One teacher shared, "*Murid dapat menggunakan aplikasi ini sendiri selepas satu sesi penerangan ringkas."* (Students were able to use this app independently after a brief introduction). Another student added, "*Saya suka sebab saya boleh ulang belajar nombor sendiri*

tanpa perlu tunggu cikgu." (I like it because I can repeat learning numbers on my own without waiting for the teacher).

6.2.3. Need for navigation and content enhancements

While overall feedback was positive, some students struggled with navigation and desired additional learning support features. A few students had difficulty transitioning between different sections of the app, particularly between learning modules and quizzes. One student commented, "*Saya kadang-kadang keliru nak pergi ke latihan selepas belajar nombor*." (I sometimes get confused about how to go to the exercises after learning the numbers). Teachers suggested adding clearer navigation cues and tutorial videos to help students use the app more efficiently. Additionally, teachers recommended expanding content by incorporating more real-life number applications, visual storytelling, and interactive elements. This feedback suggests that thorough consideration of design enhancements should be taken into consideration so that the navigation challenges could be minimized. Therefore, dealing with navigation and material holistically will probably help to increase usability and enhance students' whole educational experience with the application.

In summary, the mobile application was found to help students in learning mathematics, especially in the topic of recognizing numbers. Although most students gave positive feedback on this application, some parts of the application need improvement. Among them is that the method of navigation in the application needs to be improved so that students can more easily access the information or lesson content contained in the application. Next, the opportunity to get more relevant information can be included in the form of videos, links, and infographics so that students can gain knowledge in addition to the skills provided.

7. Discussions

The findings from this study suggest that the "*Kenali Nombor Asas*" mobile learning application was well-received by students, with no reports of distraction, disturbance, or excessive time consumption in learning mathematics. The analysis of student and teacher feedback also revealed three key themes that reflect both the strengths and areas for improvement of the application: (i) increased engagement and motivation, (ii) ease of use and accessibility, and (iii) need for navigation and content enhancements. This aligns with previous studies demonstrating that educational mobile applications can enhance engagement and self-paced learning without disrupting classroom activities [1,4]. The positive perception of ease of use and usefulness, as reflected in PP6 (ease of use) and PP7 (beneficial for learning mathematics), supports Davis' Technology Acceptance Model (TAM), which posits that perceived usefulness and ease of use significantly influence learners' acceptance of educational technology [28]. Additionally, the findings corroborate studies indicating that gamified mobile learning applications can make mathematical learning more interactive and enjoyable than traditional worksheets [13]. The high recommendation rate (PP9), where all students expressed a willingness to share the app with peers, further emphasizes its motivational appeal, reinforcing claims that digital game-based learning fosters intrinsic motivation and deeper engagement in mathematical learning [5].

However, despite these positive findings, some contradictory evidence in existing literature warrants further examination. While this study found that the application did not cause distraction, some researchers argue that mobile learning tools may increase cognitive overload in younger students, particularly if navigation and instructional design are not optimized [29]. This contrasts with the current study's findings, which suggest that navigation improvements are necessary but do not

hinder learning effectiveness. Moreover, while gamified learning has been praised for enhancing engagement, critics highlight that over-reliance on digital tools could reduce opportunities for hands-on learning and conceptual understanding, particularly in foundational numeracy skills [30]. This highlights the importance of balancing digital and traditional learning methods to maximize student learning outcomes.

Another aspect requiring attention is the lack of deep learning assessments in this study. While students reported that the app was not boring (PP5) and easy to use (PP6), the findings do not measure actual learning gains in number recognition and retention over time. Research suggests that while students may find mobile applications engaging, this does not always translate into improved performance unless combined with structured pedagogical strategies [12]. Therefore, future studies should incorporate pre-test and post-test comparisons to measure actual learning effectiveness. Additionally, navigation issues identified in this study suggest that some usability enhancements are required. Research on user experience (UX) design in educational applications highlights that intuitive interface design, accessibility features, and interactive feedback mechanisms are crucial for ensuring smooth and effective learning experiences [2]. Implementing these improvements, such as adding tutorial videos, instructional links, and infographics, as suggested in the study's conclusion, would likely enhance user experience and knowledge retention.

8. Conclusion

In conclusion, this study aims to identify the perception of Level 1 primary school students towards the use of mobile applications in learning mathematics, namely recognizing numbers. Based on the findings of the questionnaire, all respondents gave their feedback that this mobile application helped them learn mathematics easily and interestingly and is suitable for use by Level 1 primary school students. However, while "Kenali Nombor Asas" has demonstrated strong potential in engaging students and supporting numeracy learning, further refinements are necessary to ensure long-term effectiveness. The study's findings align with contemporary research on mobile learning's benefits but should also consider contradictory perspectives on cognitive overload and digital dependency. Despite the findings of this study, which answered the research questions, a few limitations should be addressed. First, this study does not assess long-term retention of learning or the enduring effects of utilizing the mobile application. This constrains the comprehension of whether advancements in number recognition are sustained over time. Second, this study relies on a limited sample of five students, rendering it challenging to extrapolate the results to a wider population and weaken the validity of the conclusions reached. Third, this study lacks a structured method for measuring actual learning gains. Specifically, there were no pre-test and post-test assessments administered, leaving an important gap in evidence regarding the app's impact on students' numeracy skills. Building on the limitations, a few suggestions are addressed. First, future research should explore learning retention, cognitive impact, and comparative effectiveness against traditional methods to provide a more comprehensive evaluation of mobile learning applications in early mathematics education. Second, research with a more heterogeneous and extensive sample size should be conducted to enhance the validity and generalizability of the results. Third, assessments, for example, pre-test and post-test, additional user interface and navigation testing, in future research would provide more concrete data on how effectively the app supports learning outcomes.

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