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Development of Banan Application Assisted the Learning Cycle 5e To Enhance Conceptual Understanding Ability

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Abstract

The advancement of technology today poses a unique challenge in the field of education, particularly requiring educators to innovate effectively. The learning media currently used are less engaging and interactive. This research was conducted to assess the effectiveness of an interactive learning media in the form of the Banan application. This study is motivated by students' low learning motivation and their poor ability to understand mathematical concepts. The teaching methods often rely on lectures, which result in students being less active during learning. The purpose of this study is to describe the feasibility and effectiveness of the Banan application assisted by the Learning Cycle 5E model. This research is a development research and development (R&D) study, namely ADDIE, which has 5 stages: Analysis, Design, Development, Implementation, and Evaluate. The method of data collection in this study involved observations, interviews, expert validation tests for media and material, questionnaires, as well as pretests and posttests instruments. The results of the media expert validation test obtained a score of 89% with a very feasible category, while the material expert validation test obtained a score of 82% with a very feasible category. Meanwhile, the effectiveness test results of the pretest and posttest showed an average Gain Score of 0.59 with moderate criteria. Student responses scored 84.17% with a very good category, while teacher responses had an average score of 83.20% with a very good category. These results conclude that the Banan application assisted by the 5E learning Cycle model is deemed feasible for use in learning.

Keywords: Application; Learning Cycle 5E; Understanding of Mathematical Concepts

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INTRODUCTION

Digital technologies for applications in fields like education are being produced at an exponential (Huang et al., 2024). The role of teaching, learning, and assessment with digital technology has become increasingly prominent in mathematics education (Weigand et al., 2024). The integration of technology in education brings positive changes to teaching. The challenges of technology opportunities cannot be overlooked for the benefit of education; these opportunities are very complex when effectively and responsibly integrated to become quality education (Cloete, 2017). It should be considered that information and communication technology must be used in education to strengthen the system and ensure more effective learning to achieve inclusive educational goals (Yalcin & Incik, 2022). The advancement of education digitalization provides opportunities for teachers to maximize utilization to improve the quality of learning. Teachers also play a crucial role in implementing new technologies in teaching (Kaźmierczak et al., 2025).

Mathematics subjects are still considered difficult because mathematics is a science that requires reasoning. Therefore, appropriate learning media can help students understand

mathematics (Saputro et al., 2018). Mathematics is considered a difficult subject for many students to understand. This is in accordance with the results of observations in class VII MTs Negeri 2 Magelang City which stated that 86% of students found it difficult to understand the material in mathematics. Based on classroom observations and interviews at MTs Negeri 2 Magelang City, teachers often explain in front so that students feel bored quickly when learning and cannot receive the material well. Students tend to become lazy and not interested in learning mathematics. the fact some of teachers still many used traditional learning method that cause students' think that mathematics is not important in everyday life, so that the students do not understand the mathematics concept, until the students' have less learning outcomes (Yuniara & Surya, 2021).

The ability to understand concepts can help students avoid many critical mistakes in solving problems. Understanding concepts is also an investment that can benefit students in many ways (Kilpatrick et al., 2001). The mathematical concepts that will be studied at the next level are also supported by an understanding of fundamental concepts, so it is important to have these abilities. This is in accordance with the initial test carried out in class VII F MTs Negeri 2 Magelang City. The average initial test score for the ability to understand mathematical concepts was 44.6. The lowest score from the initial test was 23, while the highest score was 70. The Minimum Completeness Criteria score at MTs Negeri 2 Magelang City was 78, indicating that the results of the concept understanding ability test were still below the KKM. The concept understanding test was conducted using material related to fractional numbers. Based on observations conducted in class VII F MTs Negeri 2 Magelang City, it was found that many students struggled to complete the practice questions or struggled to understand how to restate a concept.

Interactive multimedia is one of the learning media that can be used to support teachers in enhancing students' abilities (Syahputra & Maksum, 2020). Multimedia provides an engaging and interactive approach to presenting mathematical material, helping to increase student involvement in the learning process (Hartanto, 2024). Multimedia technology can enrich learning outcomes by accommodating various learning styles, offering interactive simulations, and visualizing complex concepts (Hossain, 2023). Interactive multimedia contains audio, visual, animation, and user interaction elements; these can create a more vibrant and contextual learning experience (Hasan, 2024). Therefore, interactive media plays an important role in enhancing students' understanding of mathematics (Iskandar et al., 2023).

The 5E Learning Cycle model is one that can enhance students' understanding of mathematical concepts. The learning cycle, also known as the learning model, involves students in the learning process. The 5E Model stage encourages teachers to help students deliberately and actively use their prior knowledge (Ruiz-Martín & Bybee, 2022). During the Engagement phase, students' interests are sparked, and connections are made between their existing knowledge base and the new ideas that will be presented in the lesson or unit. The Exploration stage involves presenting content and helping learners to become aware/investigate concepts, processes/procedures, facts, and/or principles. The Explanation stage focuses on enhancing students' understanding of concepts, processes/procedures, facts, and/or principles through explanations that guide them toward a deeper understanding. The Elaboration stage involves constructing new learning by helping students apply the new learning. Finally, the Evaluation stage assesses students' learning to ensure they have achieved the desired learning outcomes (Behera et al., 2024). The 5E Learning Cycle is also a student-centered learning model, which engages students actively in their learning (Okur & Güngör Seyhan, 2025). In this learning model, the engagement phase of the 5E Model is very important as it discusses several processes that are proven to be essential in promoting meaningful, sustainable, and transferable learning (Martín-Fernández et al., 2019).

Pratiwi et al (2021) conducted a study on the utilization of Android application-based learning media for enhancing concept understanding in geometric transformation material for

ninth-grade students, but the effectiveness of the application has not been tested, and no specific skills are intended to be improved using this application. A similar study was conducted by Syawala & Aulia (2023) on the development of an Android-based application as a mathematical learning medium on the topics of similarity and congruence. However, the features in the material presentation were not interactive and did not integrate learning models within the application. Additionally, the effectiveness of the application has not been tested, and the application is only used on mobile phones.

Based on the description above, this research is conducted with the aim of assessing the feasibility and effectiveness of the Banan application. This application contains interactive features that can assist students in enhancing their conceptual understanding skills with the presentation of materials integrated with the 5E learning cycle model, which can be explored independently by students. The application includes videos, animations, audio, and practice questions that can measure students' understanding ability. In addition, the practice questions presented align with the indicators of students' mathematical conceptual understanding ability. Teachers can also see students' responses after using this application through a self-reflection feature before closing the application.

METHOD

This study uses a development research methodology, with the main objective of producing educational products in the form of learning applications. This study focuses on developing valid and practical applications assisted by the Learning Cycle 5E model and evaluating its potential impact in improving students' mathematical concept understanding abilities. Researchers use research and development (R&D) methods. Development research, also known as R&D, involves the process of developing and validating educational products. In order for these items to work in the larger community, it is required to examine the needs for their production and test their efficacy (Sugiyono, 2017). This research uses the ADDIE development model. ADDIE is an abbreviation for Analyze, Design, Develop, Implement, and Evaluate (Branch, 2009). Therefore, in this study, design research is used as a methodological framework to develop learning materials in the form of applications.

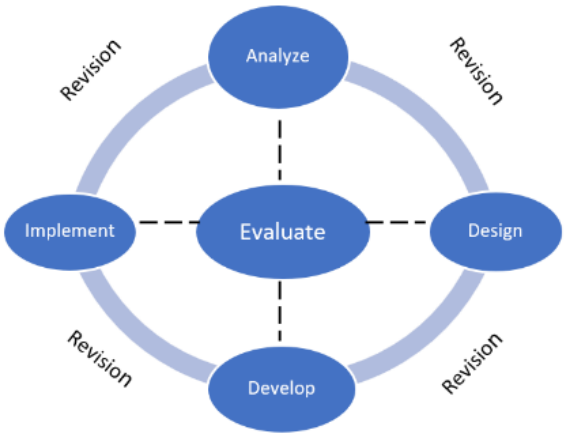

Figure 1. ADDIE Model Stages

The subject of this research is the seventh-grade students of MTs N Kota Magelang, totaling 32 people, with the sampling technique being cluster random sampling. This research uses a single-stage cluster random sampling technique, which involves randomly selecting one cluster (class) from a total population of 192 students. All students in the selected class, totaling 32 individuals, are used as samples. This technique was chosen because it is more efficient in terms of time and cost, and each class has relatively homogeneous characteristics, making it deemed capable of proportionally representing the population (Sugiyono, 2017). The trial being

investigated is the quality and feasibility as well as the effectiveness of interactive learning media using the BANAN application. The development procedure in this research can be seen in the following Figure 2.

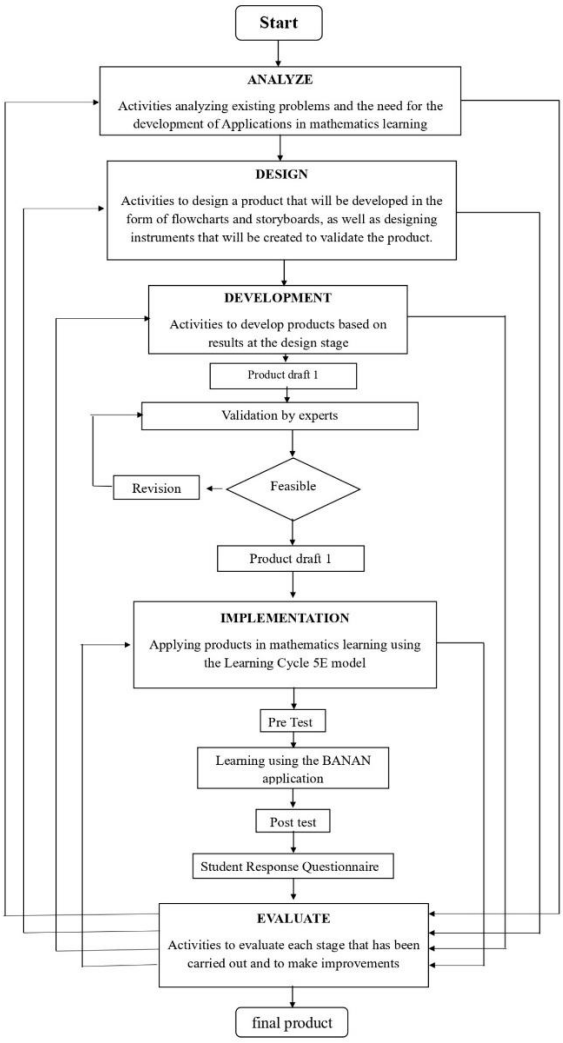

Figure 2. Research Flow of the BANAN Application Development

The learning media developed was validated by six validators consisting of three media experts and three content experts. The validation instruments for media aspects, content, and student responses in this study are presented in Table 1.

Tabel 1. Validation Instrument

Assessment Aspects	Indicators
Media	Software engineering Display feasibility
Material	Material Content Language Eligibility Understanding Mathematical Concepts in the Material Integrated Learning Model in the Material
Students response	Content Quality Technical Use Quality of Learning

Material feasibility instrument to assess the feasibility of materials. The instrument is in the form of a questionnaire with a Likert scale. The answer values are very feasible with a score of 5, feasible with a score of 4, fairly feasible with a score of 3, less feasible with a score of 2, and not feasible with a score of 1 (Sugiyono, 2014).

Tabel 2. Skala Likert

Rating Scale	Interpretation
5	Very decent
4	Worth it
3	Feasible enough
2	Less Feasible
1	Not Feasible

Analysis of Data Validation for Application Feasibility

In the development of this learning media, qualitative descriptive data analysis techniques are used. Qualitative data is obtained from observations, interviews, documentation, and data from experts as well as responses from students and teacher respondents, which are used as guidelines for revising the learning media. Quantitative data comes from validation by media experts, content experts, and student responses. The percentage analysis formula is according to Riduwan & Sunarto (2015)

$$P = \frac{\text{Total number of respondent answers}}{\text{Total number of ideal item values}} \times 100\ \%$$

The data analysis process in this research involves gathering data obtained from the questionnaire results. The expert test questionnaires (media and material) and student responses are processed using a Likert scale. The obtained data is then analyzed by calculating the total score of the questionnaire results and describing the overall results of the questionnaire.

Based on this, a categorization interpretation is made based on the scale that has been modified by (Riduwan & Sunarto, 2015). In Table 3, there are score criteria arranged according to their classification.

Tabel 3. Expert Questionnaire Scale Interpretation Table

Criteria (%)	Classification of Applications
$80 < NP \leq 100$	Very Feasible
$60 < NP \leq 80$	Feasible
$40 < NP \leq 60$	Enough
$20 < NP \leq 40$	Less Feasible
$0 < NP \leq 20$	Very Not Feasible

According to (Riduwan & Sunarto, 2015) The percentage score obtained is then interpreted into the categories based on Table 4.

Tabel.4 Interpretation Table of Student Response Questionnaire Scale

Criteria (%)	Classification of Applications
$80 < NP \leq 100$	Very Good
$60 < NP \leq 80$	Good
$40 < NP \leq 60$	Fair
$20 < NP \leq 40$	Poor
$0 < NP \leq 20$	Very Poor

The success indicator is if the validity of media experts and subject matter experts reaches a score of 60-80% in the feasible category and 80-100% in the very feasible category, while student responses reach a score of 60-80% in the good category and 80-100% in the very good category.

Data analysis techniques, besides expert testing, are also used to test the effectiveness of the BANAN application. The effectiveness data of the BANAN application usage was obtained through pre-tests and post-tests given to students before and after using the BANAN application in mathematics learning. The test used to measure effectiveness employs the Normality Test Gain (Hake, 1999). The N-Gain test criteria can be seen in Table 5 (Sundayana, 2015).

Table 5. *N-Gain*

Range of Normalised Gain	Criteria
$-1.00 \leq g < 0.00$	Decrease
$g = 0.00$	Remain
$0.0 < g < 0.30$	Low
$0.30 \leq g < 0.70$	Medium
$0.70 \leq g < 1.00$	High

RESULTS AND DISCUSSION

The result of this research is an application product called BANAN, which was created using articulate storyline software, Web 2 apk builder, and Canva. The goal of the BANAN application is to enhance students' comprehension of mathematical concepts found in congruence materials. This research employs the ADDIE model, which stands for Analyze, Design, Development, Implementation, and Evaluation. Research that develops educational software or applications uses the ADDIE model (Stapa & Mohammad, 2019). The research yielded the following results:

Application Design Output

The First step involves the creation of an application flowchart and storyboard. At this stage, the focus is on gaining an overview of the application under development. The design stage, also known as the visual thinking stage, involves preparing the necessary elements for developing learning media (Pujiastuti et al., 2020). Figure 3 displays the flowchart design.

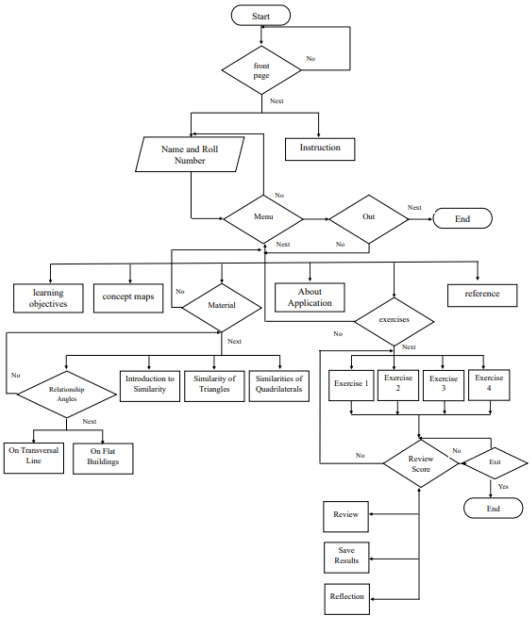

Figure 3. BANAN Application Flowchart

In addition to the flowchart, a storyboard serves as a visual representation of the application design.

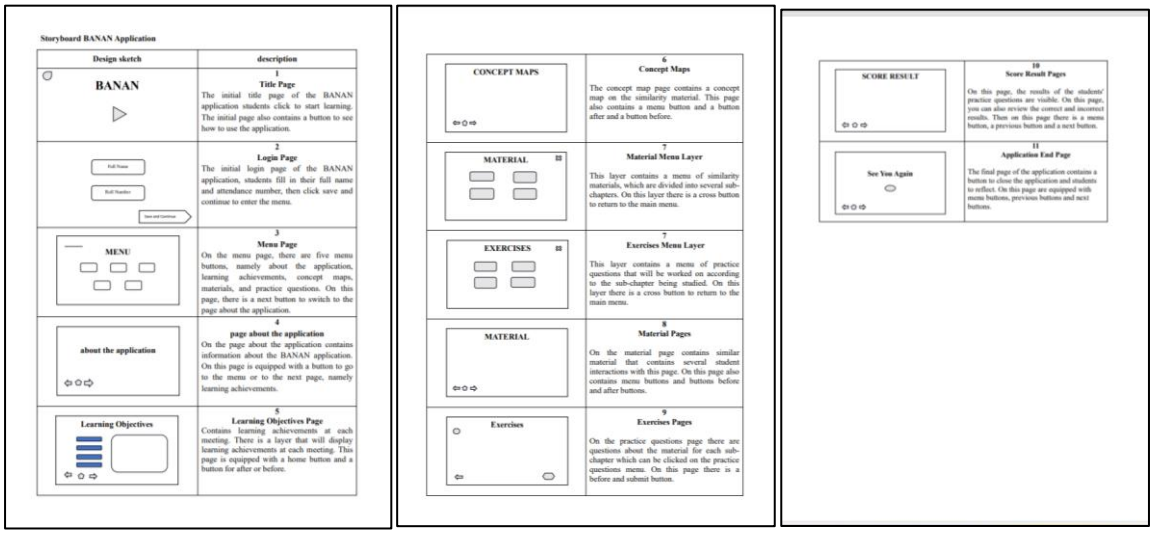

Figure 4. BANAN Application Storyboard

Developed the Banan application using an articulate storyline, following the previously created flowchart and storyboard. Figure 4 displays the results of creating the Banan application. Text, audio, and images are the main resources required. We now produce the backdrop media that will be used (Baihaki et al., 2022). Mathematics learning is believed to be important if it includes visualization (Yilmaz & Argun, 2018). The BANAN application can be accessed and downloaded via the following page https://bit.ly/BananApplication . This research product is made using Articulate storyline and website 2 apk builder. The following are the views in the BANAN application.

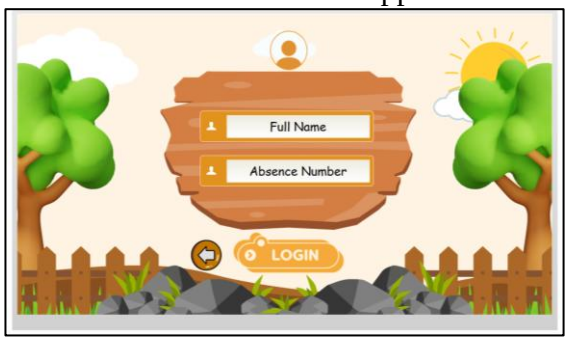

Figure 5. Initial view for login

Fig 6. Menu page

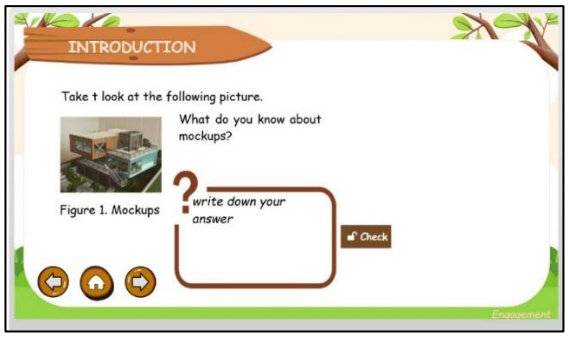

Figure 7. Engagement page

Figure 8. Explanation Page

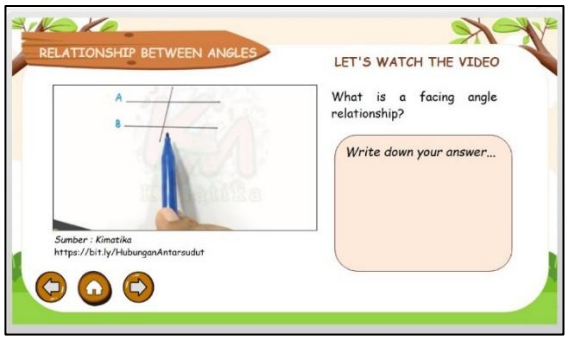

Figure 9. Exploration Page

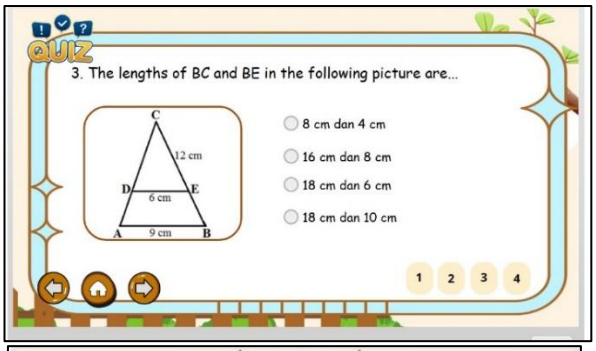

Figure 10. Evaluate and Practice Questions

Validation and Revisions

Material expert validators and media experts conduct the validation of the BANAN application. The process of validation involves the provision of a validation questionnaire sheet. The results of the validation by expert media validators are presented in Table 6 below.

Tabel 6. Media Experts Test Results

Assessment Aspects	Precentage (%)	Classification of Applications
Software engineering	88	Very Feasible
Display feasibility	90	Very Feasible
Average	89	Very Feasible

Expert validators assess the BANAN (Learning Similarity) application based on learning aspects, content, language, and the 5E Learning Cycle model. The validation results from expert validators can be seen in Table 7.

Tabel 7. Material Experts Test Results

Assessment Aspects	Precentage (%)	Classification of Applications
Material Content	82	Very Feasible
Language Eligibility	78	Very Feasible
Understanding Mathematical Concepts in the Material	83	Feasible
Integrated Learning Model in the Material	87	Very Feasible
Average	82	Ver Feasible

After the validation stage by media and material experts is complete, the BANAN application is improved based on the comments and suggestions provided by the expert team. The input provided by the expert team regarding the assessment of the BANAN application can be seen in Table 8.

Tabel 8. Media Expert Revision

Revision	Category
Arranging the score results section	Already Done
Adding formative messages to the initial display	Already Done
Creating questions that can be randomly selected	Already Done
Adding answer research features	Already Done
Move the next button in the menu	Already Done
Adding two subtopics into two different buttons	Already Done
Adding column size for student answers	Already Done

Suggestions are also provided by subject matter experts in the BANAN application. Suggestions and improvements by subject matter experts can be seen in Table 9.

Tabel 9. Material Expert Revision

Revision	Category
Add one subtopic to the concept map	Already Done
Fixing the concept of aligning angles	Already Done
Adding instructions for students to re-explain the material within the application	Already Done
Correcting the writing of angle names	Already Done
Adding the concept of similar objects	Already Done
Fixing the answer key on the example questions	Already Done
Adding the theorem of two similar triangles	Already Done
Correcting the answers in the exercise questions	Already Done

After the revision was made, a limited trial was conducted. Based on the student feedback on the limited trial involving 28 students from class 7G, it was found that the BANAN product was good with a presentation score of 79.71%.

Practiticality Result

Every lesson in the experiment class utilizes a learning realization sheet. This sheet aims to find out the practical extent of the learning application. In the meantime, we collected student and teacher responses from the experimental class to analyze the practicality of the medium. Meanwhile, the level of media practicality based on student assessments of student responses can be seen in Table 10, and the level of media practicality based on teacher assessments can be seen in Table 11.

Table 10. Result of Student Response Questionnaire Analysis

Practicality Variabel	Total Score	Maximum Score	Presentage
Content Eligibility	814	960	84.79%
Feasibility of Presentation	963	1120	85.98%
Display Eligibility	918	1120	81.96%
Language Eligibility	403	480	83.95%
TOTALLY	**3098**	**3680**	
Practicality Level		**84.17 %**	
Category		**Very Practic**	

Level of media practicality based on teacher assessments can be seen in Table 2.

Table 11. Result of Teacher Response Questionnaire Analysis

Practicality Variabel	Total Score	Maximum Score	Presentage
Content Eligibility	20	25	80%
Feasibility of Presentation	21	25	84%
Display Eligibility	30	35	85%
Language Eligibility	12	15	80%
Benefit	13	15	87%
TOTALLY	**88**	**115**	
Practicality Level		**83.2 %**	
Category		**Very Practic**	

The results of the assessment of teachers and associates in the experiment class during the 4 meetings are presented in Table 12.

Table 12. Observational Analisis of Learning Implementation

Observer's Name	Instansi	Presentage
Aryanti, S.Pd	MTs N 2 Kota Magelang	91.19%
Devi Cahya Ningrum	Universitas Tidar	91.19%

The practicality of the Banan application is known from research findings. Based on learning performance observation sheets, teacher reaction figures, and student response figures, we were able to determine the degree of learning practicality. Practicality is based on teacher responses in terms of content, language, material, and media variables. Practicality is based on student responses looking at appropriateness of content, appropriateness of presentation, appropriateness of appearance, appropriateness of language, and benefits. Meanwhile, observation reveals the learning outcomes from the perspectives of the beginning, middle, and end of the learning process.

Effectiveness Result and Interpretation

Conduct a quantitative analysis of the posttest and pretest, using the initial data test of normality, to evaluate the effectiveness of the student-level analysis activities in the experimental class. As for the results of normal calculations, see Table 13.

Table 13. Result Normality Test

Normality Result	*Saphiro Wilk*	*Wilk Table*
Pretest	0.898	0.930
Postest	0.979	

Based on table 4, it shows that the pretest scores are not normally distributed because the $Wilk_{obs} < Wilk_{table}$. Meanwhile, the posttest value is normally distributed data because $Wilk_{obs} > Wilk_{table}$. The effectiveness of the media was analyzed using the Wilcoxon test. This test's objective is to ascertain whether using the BANAN application and the 5E learning cycle model differs significantly. Table 14 presents the results of the pretest and posttest student experiments.

Table 14. Result Wilcoxon Test

Wilcoxon	*W Table*
0	159

Based on table 5, The Wilcoxon test was conducted at a significance level of 0.05. The results of the Wilcoxon test show the test statistic (W) = 0.0 because there are no negative values or decreases. The p-value is 0.000000000466. Therefore, a substantial difference

between before and after using the BANAN application can be inferred. N-gain tests use Microsoft Excel for help. The resulting N-gain scores are further adjusted to the N-gain criteria. The N-gain test scores are displayed in Table 15.

Table 15. Result N-Gain

Class	N-Gain	Criteria
Eksperimen	0.59	Medium

Multimedia is considered effective if the minimum improvement meets the moderate criteria, that is $g \geq 0{,}30$ (Pixyoriza, Nurhanurawati, & Rosidin, 2022). The graph states that the experimental class N-Gain score of 0.59 is in the "medium" category. The research findings demonstrated an increase in students' comprehension of mathematical concepts following their use of Banan application products. Following the treatment, we conduct a posttest to measure the difference. With a score of 0.56 on the medium criteria, the effectiveness test results on the n-gain test demonstrated an improvement in student learning outcomes (Farida et al., 2020).

Theoritical Reflection

The Learning Cycle 5E model, in conjunction with the BANAN application, has demonstrated effectiveness in enhancing students' comprehension of mathematicalThe Learning Cycle 5E model adjusts students' activities, questions, and practice questions in the BANAN application to gauge their understanding of mathematical concepts. concepts. Students can either learn a new concept or attempt to comprehend one that is well-known in all respects using the 5E learning cycle model (Ulaş et al., 2012). The 5E Learning Cycle model was first used by scientists in science courses like biology, chemistry, and physics because it could support lab exercises. But for a variety of reasons, a lot of teachers are increasingly using this concept in math classes (Gradini & Susanti, 2022).

Teachers should create a state of disequilibrium with students' existing conceptions, forcing them to rethink and attempt to reconstruct understanding. Students should be able to actively engage in the learning process and build their own knowledge through constructivism (Suwito et al., 2020). Students actively participate in the BANAN application by working in groups. The teacher encourages student participation by giving them the freedom to learn mathematics at their own speed. (Anthony & Walshaw, 2009). Students' learning performance improves by collaborating and involving them (Qureshi et al., 2023).

In addition, the Banan application's language adheres to enhanced spelling (EYD), is easy to understand, and is communicative. We hope that the use of appropriate language for the student's developmental level will aid their learning of the material (Humaidi et al., 2021). According to media professionals' evaluations, the application is easy to use, and the development tools are suitable. The clarity of the instructions for using the application is good. The interactive capabilities in the application are good. In terms of visual communication, the choice of typeface, letter spacing, text readability, layout settings, color composition, and color selection are all appropriate. In addition, the design exudes attractiveness and neatness, and the navigation buttons exhibit correct construction. The benefits of technology-based learning media in mathematics education include its engaging nature, ability to prevent boredom, and ability to boost motivation for mathematics learning (Lu'luilmaknun et al., 2021).

Moreover, the 5E Learning Cycle model, in conjunction with the BANAN application, can bolster the constructivist learning theory. Students can engage in illustrating mathematical concepts in a more dynamic and visual way by including multimedia components like animation, sound, video, and simulations (Anglia & Sutomo, 2024).

CONCLUSION

This development is carried out to assess the feasibility, practicality, and effectiveness of the BANAN application assisted by the Learning Cycle 5E model for educators and learners.

The development of this application is very interesting with integrated learning steps within the application, making it easier for educators and learners to study anytime. The feasibility test of this application by content experts scored 82% and media experts 89%, with criteria deemed very feasible.

From the results of the development of the Banan application, the understanding ability of students before and after using the Banan application improved by 0.59, which is categorized as moderate, thus this research is said to be effective. In addition, the ease of operating the Banan application can help students learn, as indicated by the students' responses to the Banan application with a percentage of 84.17%. Students find it easy to operate this application using a mobile phone or computer.

There are several limitations in the development of the Banan application, namely that activities during learning cannot be saved properly except for the student self-reflection section which is connected to Google Forms. Additionally, this application cannot be installed on iOS, so for learning outside of Android, it can be installed using a computer.

RECOMMENDATION

Based on the research that has been conducted, it is recommended for future studies to pay attention to the following: (1) This application cannot yet be installed on IOS, so it is hoped that future research can develop it or make it accessible through the web. (2) The Banan application has not yet been able to save each student's activities. (3) This application does not fully connect with teachers, so it is hoped that this application can be developed so that its activities can also be monitored by teachers online.

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