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Development of Android Media Based on a Realistic Approach in Blended Learning to Improve Students' Problem-Solving Skills

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ABSTRACT

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In the field of education, there is evidence suggesting that students' proficiency in mathematical problem-solving remains subpar, while the utilization of diverse learning tools is not fully optimized. This research is motivated by the imperative to address these challenges. This development research utilizes the Plomp & Nieveen Development model to assess the validity, practicality, and effectiveness of Android media based on a realistic approach in improving students' mathematical problem-solving skills. Through trials I and II, the research findings indicate the successful development of Android media that meets the criteria of being valid, practical, and effective. The results also show an increase in students' problem-solving skills using the Android media, with the N-gain value progressing from 0.55 in trial I to 0.60 in trial II, categorizing it as "medium" improvement. This finding underscores the potential efficacy of incorporating digital tools, such as Android media, in educational practices to enhance students' problem-solving capabilities within the realm of mathematics.

A. INTRODUCTION

As we journey through life, we encounter a multitude of transformations and advancements. Education, an integral component of our existence, is constantly evolving to keep up with the rapid pace of change. As curious beings, we possess an insatiable thirst for knowledge in all its forms. According to Rahman et al. (2022), education encompasses a deliberate effort to transfer cultural wisdom from one generation to the next, ensuring that each new cohort embodies the teachings of its predecessors. However, defining education completely is a complex undertaking, given its vast and varied audience, which encompasses all of humanity.

The pursuit of education and the journey of learning are deeply intertwined, with mathematics being a fundamental subject taught from an early age through higher education. According to Harahap and Lubis (2021), mathematics is a universal science that holds a vital role in the advancement of modern technology and various academic fields, as well as in enhancing cognitive abilities in humans.

It is essential for students to develop problem-solving abilities when learning mathematics. According to Das in Hidayat (2022), problem-solving offers various benefits to students, including improved critical thinking skills, the ability to apply procedures, and a deeper understanding of concepts. These abilities are vital in preparing students to face the challenges of a rapidly changing world.

Mathematics is a crucial discipline that serves as the cornerstone for a wide range of scientific fields. It involves the study of assumptions, properties, and applications, which enhances students' capacity for systematic and logical thinking. Despite its significance, many students tend to shy away from math lessons. According to Widjajanti (2009), students find math to be a challenging subject that lacks practicality, beyond the realm of basic counting. Furthermore, the teaching methods employed by educators are frequently less varied and less captivating. Therefore, it is incumbent upon instructors to reexamine math instruction to improve its appeal and enjoyment for students.

In the classroom, mathematics can be taught using various approaches, including Realistic Mathematics Education (RME) or the Indonesian Realistic Mathematics Education. According to Agustina et al. (2020), RME commences with relevant and practical concepts, aiming to cultivate students' abilities through discourse and collaboration with peers. Furthermore, it provides them with opportunities to solve problems independently as well as in groups. There are different ways to teach mathematics in the classroom, and one

of them is the Realistic Mathematics Education (RME) approach, also known as the Indonesian Realistic Mathematics Education. According to Agustina et al. (2020), this approach starts with concepts that are "real" or relevant to students, and it focuses on developing their skills, encouraging discussion and debate with their peers, and enabling them to solve problems both alone and in groups.

The 21st century has seen a rapid advancement in technology. In today's globalized world, it's vital for individuals to create new electronic devices and machines to assist them in their work and achieve their objectives. As per Haryanto (2019), technology has impacted every single aspect of life, including education. It's crucial for both teachers and students to possess the necessary skills to teach and learn in the 21st century, tackling challenges and opportunities in the information age. One such development in education is the utilization of Information and Communication Technology, including electronic learning (e-learning), as a learning medium from early childhood education to the university level. Technology has been advancing rapidly since the start of the 21st century. In today's globalized world, it's crucial for people to create new machines and electronic devices to aid in their work and achieve their goals. According to Haryanto (2019), technology has impacted every aspect of life, including education. Both teachers and students must have the necessary skills to teach and learn in the 21st century, facing challenges and opportunities in the information age. One such development in education is the use of Information and Communication Technology, which includes electronic learning (e-learning), as a learning medium from early childhood education to the university level.

In Indonesia, smartphones have become an increasingly popular resource for learning and technological development, utilized by both parents and teenagers. Among the various operating systems available, Android-based devices have established themselves as the most widely used, with a market share of 63.15%. Windows follows behind with a market share of 26.73%, while iOS holds 5.93%. Unidentified devices hold a 1.8% market share, followed by OS X at 1.61%, and Linux with a market share of 0.7% (StatCounter, 2022).

The Android operating system is renowned for its open platform that allows developers to create their own applications. This feature makes it a highly sought-after platform for mobile app development. In the field of education, this presents a great opportunity for teachers to leverage technology and create innovative learning media through Android-based media.

By utilizing Android's open platform, educators can customize their own learning applications to cater to the specific needs of their students. This can include interactive learning modules, educational games, and other engaging tools that facilitate active learning and make the educational experience more enjoyable.

In addition, Android provides a vast range of resources and programming tools that can be used to develop high-quality educational apps. This includes access to a large community of developers, support for multiple programming languages, and an extensive library of code samples and tutorials. As such, the possibilities for creating effective and engaging educational media on the Android platform are virtually limitless.

Overall, the open platform design of Android provides educators with a powerful tool to create customized learning experiences that can improve student outcomes and enhance the overall quality of education.

Mobile learning is a type of education that can help in the learning process, particularly with the extensive use of mobile devices and smartphones in the 21st century, especially Android-based media. Smartphones, particularly Android, are easily accessible and portable, making them a convenient way to access learning materials. They also provide opportunities for self-paced learning and serve as an evaluation and feedback tool for students. In today's digital age, mobile learning has become an increasingly popular method of education. With the widespread use of mobile devices and smartphones, particularly those that operate on the Android platform, learning has become more convenient and accessible than ever before. These devices offer a portable and user-friendly way to access educational resources, enabling self-directed and personalized learning. Additionally, they can serve as an effective tool for evaluating progress and receiving feedback.

In the field of mathematics education, it is apparent that many educators still rely on conventional teaching techniques, such as blackboard lectures. However, after conducting an interview with a math teacher, it was discovered that students often experience difficulty with problem-solving due to a lack of understanding of fundamental concepts. According to Firdaus et al. (2019), the primary objective of learning mathematics is to equip students with the ability to think critically, analytically, methodically, and creatively, allowing them to effectively convey ideas based on the knowledge they have acquired.

A researcher has created an innovative Android application that takes the form of engaging and interactive worksheets and teaching materials. The application is based on the Blended Learning Realistic method, which expertly combines both face-to-face and virtual learning methods to create a highly effective and optimized learning experience. This sustainable model has been specially designed to help students learn and can be an invaluable resource for teachers seeking high-quality, Android-based learning media.

Realistic Mathematics Education (RME) or Realistic Approach

Realistic Mathematics Education (RME) is an innovative approach that leverages real-world situations to facilitate effective learning. According to Panhuizen and Drijvers (2014), RME involves the use of contextually relevant scenarios to teach mathematical concepts, methods, and tools. This methodology enhances the practical application of mathematical knowledge in everyday scenarios, leading to a deeper comprehension of the subject matter. Additionally, this approach promotes the acquisition of universal and formal knowledge that students can apply across various contexts. In summary, RME's emphasis on realistic scenarios is a critical component that makes it an ideal tool for developing a comprehensive and sophisticated grasp of mathematics.

Android-Media Development

Ismayani (2018) suggests that Android-based media has gained popularity as a learning tool, owing to its effectiveness and efficiency. Google Corporation developed Android, an open-source mobile operating system, which allows developers to create applications for various mobile devices. Its convenience and flexibility make it a favored option for educational purposes, enabling independent learning for individuals both in school and at home. This underscores the potential of Android-based learning media to provide accessible and enjoyable learning opportunities for all.

Blended Learning

According to a study authored by Tabunan et al. (2020), blended learning refers to a teaching approach that combines the use of the internet and digital media with traditional classroom instruction, requiring both teachers and students to be physically present. Meanwhile, Fatirul and Walujo (2020) note that blended learning incorporates both online and traditional classroom methods, while also fostering social interaction. This approach also allows for virtual meetings, enabling educators and students to exchange feedback, ask questions, and collaborate, regardless of their physical location.

Problem-Solving Skill

In 1973, Polya put forth four critical stages for effective problem-solving: comprehending the problem and determining its requirements, analyzing the relationships between different elements and the unknowns to devise a plan, executing the plan, and finally reviewing and discussing the completed solution. These steps and markers are utilized in research to assess individuals' mathematical problem-solving skills. It is clear that solving problems requires a considerable amount of thought and consideration before arriving at a solution. As a result, problem-solving can significantly impact a person's ability to generate innovative ideas that are valuable for future problem-solving endeavors.

B. RESEARCH METHODS

The research paradigm under consideration is comprised of three distinct stages, namely: preparatory investigation, advancement or prototyping, and appraisal. The focus of this study is on media development, and it utilizes a modified version of Plomp and Nieveen's development model to conduct the examination. The purpose of this research is to gain a deeper understanding of the developmental processes involved in media creation and to identify areas where improvements can be made. The subjects in this research were representatives of class XI students. By analyzing the results of this study, researchers will be better equipped to create more effective and efficient media products that meet the needs of their target audiences.

The Android media created employing a practical approach must meet the criteria of being substantial, viable, and compelling. It is considered valid if it falls under the valid category of $4 \leq Va < 5$ or is very valid if $Va = 5$. It is practical if the average score obtained from the learning media implementation sheet in class is at least good ($3 \leq Ok < 4$). It is effective if : 1) The least test score for students' problem-solving capacities considering capacities is 70, and at least 85% of students achieve learning mastery, 2) Based on student responses, it is considered positive if it meets the criteria for being effective with the media, which is reaching a percentage of ≥ 80%.

To calculate the increase in problem-solving skills after using Android media development based on a realistic approach, the normalized $N - Gain$ formula according to Susanto, J. (2012) is as follows:

$$N - Gain = \frac{S_{post} - S_{pre}}{S_{max} - S_{pre}} \quad (1)$$

Information:

$N - Gain$ = Normalized gain score

S_{post} = Final test score
S_{pre} = Initial test score
S_{max} = Maximum test score

Table 1. Normalized Gain Criteria

Score	Criteria
< N - Gain ≤ 0,30	Low
0,30 < N - Gain ≤ 0,70	Medium
N – Gain > 0,70	4.7

C. RESULT AND DISCUSSION

Result

Preliminary Stage

The study conducted by Global Lentera Kasih Batam aimed at identifying the obstacles faced during the learning process. The study analyzed the data obtained from the analysis to determine the need for developing suitable learning media. The results of the study are significant in providing insight into the learning process and identifying potential areas of development in the field of education. The findings of the study could be beneficial to educational institutions and organizations looking to enhance their learning strategies and provide a better learning experience for students.

The blackboard is one of the most frequently utilized tools in the classroom. In interviews with mathematics educators, it was revealed that students' capacity to solve problems is deficient. The assessment of daily tests on Class XI materials during the 2022 academic year indicated that only 69.57% of students achieved the minimum completion criteria (KKM).

During the development or prototyping stage, researchers worked on designing a product that could meet the needs of their target audience. They started by creating a draft of an Android media device, which would be the foundation for the final product. This device was designed to be user-friendly and accessible to a wide range of users. To ensure that the device would meet the expectations of their target audience, the researchers also developed a realistic app that would be compatible with the device. This app was designed to provide users with a seamless experience that would allow them to easily access and enjoy multimedia content on the device. Through this process, the researchers were able to refine their product design and create a prototype that was ready for further testing and evaluation..

Development or Prototyping Stage

The present study showcases an exemplar of an item plan, utilizing Kodular and supplemented by lesson plans and product quality assessment instruments. Figure 1. presented below provides a graphical representation of the item plan.

Figure 1. Product Design View

Evaluation dan Revision. Android media things, lesson plans, and thing quality assessments were made based on a commonsense approach (Draft I) and looked into by three pros. The average value of the validation results is as follows: 1) media experts amounted to 4.13; 2) material experts amounted to 4.47; 3) the test of problem-solving skill skill of students as an assessment instrument met the criteria of valid and reliable. A few

revisions from the experts regarding the selection of images and the resolution of the images and text used were considered and adjusted so that it became draft II.

Assessment Stage

After carefully considering the recommendations put forth by industry experts, a series of field trials were conducted on the subjects of our research, specifically focusing on students in the eleventh grade of PKBM Global Lentera Kasih Batam. This approach allowed us to test the efficacy and feasibility of our research methodology in a real-world setting, thus providing us with valuable insights and data that can be utilized to further refine and optimize our research objectives.

Result of Trial I

In class XI-B, the product (draft II) was put to the test for its practicality and effectiveness. Unfortunately, the first trial yielded poor results, with an average score of 2.88 ($2 \leq Ok < 3$), falling short of the practicality criteria. Moreover, the classical completeness of students' problem-solving skill did not meet the required standards, scoring 73.68%, respectively. Despite this, the student's overall response was positive, with an average score of 87.67%.

Given the unsatisfactory results of the first trial, it was evident that the product needed revision before the second trial could be conducted. As such, a third draft (draft III) was created.

Result of Trial II

During Trial II, a product (draft III) was tested in class XI-A to assess its practicality and effectiveness. The comes about of perception demonstrated that the learning usage was effective, with a normal score of 3.74, assembly the criteria for a common sense of learning media. Besides, the classical completeness of students' problem-solving capacity in Trial II was 89.47%, assembly the criteria for classical completeness. The normal understudy reaction was 93.09%, showing a ideal reaction to the learning strategy.

Description of the Improvement of Students' Problem-Solving Skill

Amid the primary trial, students' problem-solving abilities had an normal pre-test score of 47.62 and a post-test score of 78.95. The normal N-gain was 0.55, which is considered "medium" ($0.30 < \text{n-gain} \leq 0.70$). Within the moment trial, the normal pre-test score was 53.18, and the post-test score was 80.81. The normal N-gain was 0.60, too falling within the "medium" category. Based on these comes about, it can be concluded that the utilize of android media, created with a reasonable approach, driven to an increment in students' problem-solving aptitudes from trial I to trial II, as prove by the overall normal esteem and the normal esteem of N-Gain.

Discussion

A legitimacy test was carried out to evaluate the primary adaptation of an Android media application. The application was made to address the challenges confronted by Course XI PKBM Global Lentera Kasih Batam. The development team consisted of three experts who utilized a practical approach. The validation results from the three validators indicated that the application was valid, with an average media expert validity of 4.13 and material expert validity of 4.47. The problem-solving skill test instrument skill test were also deemed valid based on the test results, which showed $t_{count} > t_{table}$. The reliability of the pre-test and post-test for the tests was high, with scores ranging from 0.697 to 0.717.

Upon conducting a thorough examination, it has been deduced that the Android media produced utilizing a realistic approach conforms to the validity criteria established by experts. The success of this approach can be attributed to various factors. Primarily, the Android media has attained content validity by aligning with the demands of the current curriculum. These demands pertain to the essential competencies that pupils must acquire through educational activities that cater to the lesson's material and are based on the realistic mathematics learning approach.

A team of validators recently conducted a thorough examination of android-based learning tools that were developed with a realistic approach. Their findings indicated that the tools were indeed feasible, with only minor revisions required. The study evaluated the tools' effectiveness from three distinct perspectives: the implementation of learning steps, social systems, and management principles with support systems. This evaluation was conducted in class XI-B PKBM Global Lentera Kasih Batam, with 19 students participating in the study.

Based on the assessment results from the validators, all of them stated that the android media developed using a realistic approach was feasible to use with minor revisions.

An assessment was conducted to gauge the efficacy of Android-powered educational resources that followed a lifelike approach. The assessment was approached from three angles: the execution of learning processes, social systems, and management principles with supplementary systems. The investigation was performed on 19 students from XI-B class of PKBM Global Lentera Kasih Batam. The average score for

learning execution was 2.881, indicating that the product did not satisfy the criteria for practical and effective learning implementation.

After the initial trial of the new learning media (draft II), it was discovered that the media did not meet the established practicality standards due to a lack of preparation in managing student activities. To address this issue, a second trial (known as trial II) was conducted with 19 students in class XI-A PKBM Global Lentera Kasih Batam. The trial took place over three sessions, during which the teacher guided students in using the new learning media (draft III) more efficiently.

In trial II, the teacher was better prepared to manage the learning process, and the implementation of learning received an average score of 3.738 (in the "Well Implemented" category). This indicates that the product's practicality criteria were met in terms of learning implementation.

Based on the results of trials I and II, it can be inferred that the android media utilizing a realistic approach has proven to be practical and user-friendly for both teachers and students. The android media components developed using this approach have been well-received by students, as demonstrated by the positive outcomes of the trials.

During trial I, the android media fell short of meeting the classical completeness criteria for problem-solving skills, achieving only 73.68%. This may have been due to limitations in the learning media utilized during the initial trial.

However, in trial II, the android media based on the realistic approach successfully met the classical completeness criteria for problem-solving skills, achieving an impressive 89.47%. As a result, it can be concluded that the android media developed using this approach is highly effective in enhancing students' problem-solving skills.

The analysis of the improvement of students' mathematical problem-solving skills in both pre-test and post-test results shows that there was an increase in the average mathematical problem-solving skill in trial I from 53.62 to 78.95, and in trial II from 53.18 to 80.81. The increase in mathematical problem-solving skill was also evident in the average normalized gain. In trial I, there was a score of 0.55 with "medium" criteria ($0.30 < \text{n-gain} \leq 0.70$), and in trial II, there was a score of 0.60 with "medium" criteria. This indicates that the use of Android media based on the realistic approach had a positive impact on improving students' mathematical problem-solving skills.

D. CONCLUSION AND SUGGESTIONS

Upon careful analysis of the research findings and through extensive discussions, it is apparent that Android media, which is grounded in a realistic approach, fulfills the necessary criteria of being valid, practical, and effective. It is noteworthy that the use of Android media has resulted in a significant improvement in students' mathematical problem-solving abilities. Therefore, it is recommended that Android media based on a realistic approach be incorporated into learning activities.

Educators looking to integrate media into their lessons are encouraged to supervise their students' cell phone activity during class. For fellow scholars seeking to delve into comparable research, delving deeper into the potential of the Kodular application (or similar software supporting the creation of Android-based educational media) would prove advantageous. The research revealed that crafting a single subject matter demanded a substantial amount of time; thus, there is a call to promote the advancement of application-based educational media that is not confined to the Android framework.

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