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THE POWER OF ANDROID-BASED INTERACTIVE MULTIMEDIA TO IMPROVE LEARNING OUTCOMES IN SCIENCE LEARNING

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ABSTRACT

This study aims to determine the comparison of student interest and learning outcomes and to determine the difference in increasing interest and learning outcomes between students who learn using interactive multimedia based on android and power point. The research method used with a quantitative approach and

quasi-experimental research design. The number of samples studied in this study were 48 students, 24 experimental class students and 24 control class students. The results showed that before the application of android-based interactive multimedia, the average value of learning interest in the experimental class was 38.05 and the average value of learning outcomes was 44.80. Before the application of PowerPoint, the average value of learning interest in the control class was 38.35 and the average value of learning outcomes was 45.20. After applying android-based interactive multimedia, the average value of interest in learning in the experimental class was 78.13 in the strong category and the average value of learning outcomes was 84.60. After applying PowerPoint, the average value of learning interest in the control class was 56.48 in the moderate category and the average value of learning outcomes was 71.80. Based on the independent sample t test, the sig value is 0.000 <0.005, so Ha is accepted, meaning that there are differences in learning interest and learning outcomes between the experimental class and the control class.

KEYWORDS: Mobile Communication; Android; Education; Artificial Intelligence; Sciences.

1. INTRODUCTION

The implementation of education is realized through the learning process, which is an interaction between teachers and students within a learning environment designed to achieve learning objectives, namely the skills students are expected to possess after the learning process. This aligns with Arfani's (2016) opinion that learning is essentially an interaction process between students and their environment, resulting in behavioural changes for the better. Effective and efficient learning implementation will be achieved by involving and integrating several related elements to achieve the established learning objectives. Supardi (2013) states that effective learning is a structured combination of people, materials, facilities, equipment, and procedures aimed at changing student behaviour in a positive and positive direction, in accordance with their potential and differences, to achieve the established learning objectives.

Learning is viewed as a system consisting of interrelated and interdependent components (Sanjaya, 2012). Learning as a system comprises several subsystems or components, including teachers, students, objectives, materials, media, methods, and evaluation. The human elements involved in learning consist of the students who learn, the teachers who teach, and other staff or personnel who help the continuity and smoothness of the learning process in achieving the expected goals, such as laboratory personnel, administrative staff, and so on. Meanwhile, the material elements included in the definition of learning include books, blackboards, chalk, photography, slides and films, as well as audio and video tapes. Meanwhile, facilities and equipment include classrooms and audio-visual equipment including computers or OHP (Overhead Projectors). As for procedures in learning, such as the schedule and method of delivering information, practice, studying, exams, and so on.

Current technological advancements and developments have transformed learning patterns, including the transition from classroom learning to anytime and anywhere, thanks to the use of information technology in learning. Technological advancements offer numerous options for education to support the learning process, making it more effective and efficient for students (Machii, 2016). Information and communication technology can be utilized as a learning medium, both as a tool for teachers to deliver material to students and as a learning resource. Educational institutions must begin integrating and introducing information technology into learning (Darmawan, 2015).

M-Learning is a learning approach that involves mobile devices such as mobile phones, PDAs, laptops, Android devices, and tablet PCs (Darmawan, 2012). With these devices, learners can access materials, instructions, and applications related to the lesson without being limited by space and time, wherever and whenever they are. Consistent with research conducted by Rumengan, Yuliana, and Talakua (2020), mobile learning has been shown to have numerous positive effects on learning.

The implementation of Android-based interactive multimedia is part of a mobile learning approach. Multimedia is an application that integrates media elements such as audio, text, images, video, and animation. Interactivity is a feature that provides information or feedback according to user control. Furthermore, Android is the operating system for smartphones. Research on Android-based interactive multimedia has had a positive impact, including (Agustin, 2024) stating that Android-based interactive multimedia helps improve interaction between students and teachers. Furthermore, research (Rahman, 2021) indicates that Android-based interactive multimedia can increase student learning motivation during school activities.

Initial observations at Mekarmukti Elementary School revealed that the use of smartphones as a learning medium has not been well-implemented and developed. A survey of the total number of students revealed that they already own mobile phones, most of which have advanced and comprehensive features and facilities, such as video, Java, MP4, MP3, and Android devices. However, teachers have not yet been able to utilize them. Furthermore, to encourage students to use smartphones for entertainment, such as browsing social media, the researchers attempted to utilize smartphones in learning. Furthermore, complete facilities supporting learning activities, such as a computer lab, projector, sound system, and other facilities, are available. However, this situation has not yet encouraged teachers to utilize the available resources and facilities.

In addition to the aforementioned issues, low student learning outcomes are related to student understanding of science, particularly in fifth grade at Mekarmukti Elementary School. The average score obtained by students is 70, compared to the ideal score of 75, which is the Minimum Completion Criteria (MCC). This is likely due to the material delivery process (learning) which still uses less varied learning media, thus reducing student interest in learning. Furthermore, 18 and 15 students stated

that science is a difficult subject, which impacts their motivation to participate in learning. This is in line with research findings (Aprijal,2020), which show that student interest in learning is a key factor in learning activities and will influence overall student learning outcomes.

2. LITERATURE REVIEW

2.1. Android-Based Interactive Multimedia

Mobile communication is the process of exchanging information between individuals or groups through mobile devices, such as smartphones, tablets, or laptops. Mobile communication theory discusses how mobile technology influences human communication behaviour and how individuals interact with mobile technology. The main theory of mobile communication is the Uses and Gratifications Theory (Hajdarmataj and Paksoy,2023). This theory states that individuals use mobile technology to full-fill their needs and desires, such as the need for information, entertainment, or socialization. Furthermore, the Diffusion of Innovations Theory (Rogers and Everett 1983) explains how mobile technology is adopted and used by individuals and groups. From a community perspective, mobile communication is based on the Theory of Social Change (Coughenour and Applebaum, 1972). This theory states that mobile technology enables individuals to connect with others and form social relationships wherever they are (Gültekin and Bayat 2014).

Therefore, the main concept of mobile communication is mobility, which refers to the ability of individuals to move and communicate through mobile devices (Alkhazaali et al, 2017). Next is Connectivity, namely an individual's ability to connect with other people and social networks through mobile devices. Finally, Interactivity, namely an individual's ability to interact with mobile devices and digital content.

On the other hand, mobile communication has changed the way individuals communicate and interact with technology. Mobile communication theory discusses how mobile technology influences human communication behaviour and how individuals interact with mobile technology, as discussed in (Mc Quail and Mark Deuze, 2020). However, mobile technology also has criticisms and challenges that need to be addressed to ensure its effective and responsible use, as examined by (Rodi and Stevanovi,2015).

Multimedia is a combination of various media including text, images, sound, animation, video, and interactions integrated into digital files used to convey information to users. "Multimedia refers to the delivery of information through a combination of text, images, audio, and video, which are processed through two separate cognitive channels in the brain: the visual channel (for pictures and other visuals) and the verbal channel (for words)" (Mayer, 2001). There are 12 principles studied in multimedia (Mayer, 2001), including the principle of coherence, the principle of signal, the principle of redundancy, the principle of spatial approach, the principle of temporal approach, the principle of grouping, the principle of pre-training, the principle of learning models, the principle of personalization, the principle of sound (speech), and the principle of multimedia.

The definition of interactive refers to communication between two or more parties that provide mutual feedback. Communication in interactive multimedia is the relationship between humans (as users) and computers in the form of software/applications/products in a specific file format, usually on a CD. Based on the definitions of multimedia and interactive above, interactive multimedia is a multimedia display designed by designers to full-fill the function of informing messages and providing interactivity to its users. Multimedia is widely used in various fields, including learning media, games, films, medicine, military, business, sports, and so on. advertising/promotions, etc. When users have the freedom to control the multimedia, it is called interactive multimedia (Munir, 2015).

Interactive multimedia is the combination of various communication channels into a coordinated communicative experience where an integrated, cross-channel language of interpretation is absent (Elsom-Cook, 2001). Reddi and Mishra (2003) define interactive multimedia as the integration of multiple media elements (audio, video, graphics, text, animation, etc.) into a synergistic and symbiotic whole that provides greater benefits to the end user than any one media element could provide individually. Interactivity creates a two-way relationship, thus creating a dialogue between two or more users (Munir, 2015). It can be concluded that interactive multimedia is a combination of several media such as images, text, video, animation, and audio integrated into a single element/multimedia used to convey information to the user so that the user can control the product.

Android is a Linux-based operating system used on smartphones and tablet computers. middleware, and main applications (Nazarudin,2012). Like Linux,

Android also provides an opensource platform that developers can use to create their own applications. In general, Android is an opensource platform for developers to create their own applications for use on various mobile devices. Android's characteristics include a complete platform, an opensource platform, and a free platform.

2.2. Learning Motivation

Interest is a desire, wish, or liking (Makmun Khairani, 2014). In the learning process, students as learners are required to have a strong interest in learning activities so that learning objectives can be achieved effectively and students can interact with their learning resources. Interest in learning is the heart's inclination to learn to acquire information, knowledge, and skills through effort, teaching, or experience. Interest in learning is an element that motivates students to pursue knowledge, rooted in their sense of interest, joy, and desire to gain knowledge (Furqon,2024).

In relation to learning implementation (Andi, 2019), interest in learning functions to generate attention, facilitate concentration, prevent external distractions, strengthen the retention of learning material in memory, and minimize learning boredom. The influence of interest in learning activities significantly influences students' ability to achieve the abilities set by the teacher in the learning process (Aprijal,2020).

2.3. Learning Outcome

Learning outcomes are the abilities students possess after undergoing learning experiences. These abilities encompass cognitive, affective, and psychomotor aspects. Learning outcomes can be observed through evaluation activities aimed at obtaining evidence-based data that will indicate the level of student ability in achieving learning objectives. Generally, learning outcomes can be classified into three aspects or domains: cognitive, affective, and psychomotor. These three domains are integrated and referred to as competencies.

Each subject has a learning outcome formulation, outlined in the learning objectives, encompassing these three domains or aspects. The emphasis varies depending on the subject matter. For example, practical subjects emphasize the psychomotor domain, while conceptual understanding subjects emphasize the cognitive domain. However, both domains contain the affective domain (Haryati, 2007). Sujana (2016) broadly divides them into three domains: 1) the cognitive domain, which concerns intellectual learning outcomes and consists of six aspects: knowledge or memory, understanding, application, analysis, synthesis, and evaluation; 2) the affective domain, which concerns attitudes, interests, and values. There are five aspects of the affective domain, namely: receiving, responding, assessing, organizing and characteristics; 3) the psychomotor domain is related to learning outcomes, skills and the ability to act. There are six aspects of the psychomotor domain, namely reflex movements, basic movement skills, perceptual abilities, harmony or consistency, complex and expressive and interpretive skill movements.

3. METHOD

The research method used in this study was an experimental method with a quantitative approach. Darmawan (2013) states that quantitative research is a process of discovering knowledge that uses numerical data as a tool to find information about what we want to know. The experimental design used was a Quasi-Experimental Design, a design that includes a control group but cannot fully control external variables that influence the implementation of the experiment (Darmawan, 2013). The research design used in this study consisted of two groups: one experimental group and one control group. The control group was class 5A and the experimental group was class 5B, selected without randomization. To prepare the form of treatment in this research, it was specifically developed as a characteristic of educational technology research, namely utilizing the VCDLN database system and producing science materials themselves which were uploaded to the online database system which was accessed via an Android mobile phone. This study began with a pre-test before the treatment was administered and a post-test after the treatment was administered. The pre-test in this research design can also be used for statistical control and to measure score achievement (gains core).

The population consisted of fifth-grade students at Mekarmukti Elementary School, and the research sample included 48 students in grades 5A and 5B. The sampling technique was carried out using purposive sampling with the consideration or criteria that students have had learning experience and have an understanding of the properties of objects as prerequisite skills.

4. RESULT

From the research products obtained to test the level of motivation to learn Elementary School students in Scientific lessons, this was developed based on an Android-based e-learning as an

interactive multimedia model which can be seen in Figure 1 below.

Figure 1: Development of Android-based Interactive Multimedia.

Table 1: Comparison of Pretest Values of Interest and Learning Outcomes of Classes VA and VB

Velue	Class/Group			
	5A (Experiment)		5B (Control)	
	Interest	Learning outcomes	Interest	Learning Outcomes
Average	38,05	44,80	38,35	45,2
Max	44	60	45	60
Min	30	30	30	35
Number of Students	24		24	

This e-learning system, powered by mobile technology, was developed in collaboration with educational technology experts (Darmawan,2025). It includes comprehensive scientific materials, a search facility for key topics, and online evaluation facilities. The system's support is based on the WELS (Web-Based Electronic Learning System) research product, (Darmawan, D, et al., 2027). The interactive multimedia product system can be truly felt by students and teachers during the learning process, as seen in Figure 2, which shows its interactive multimedia features.

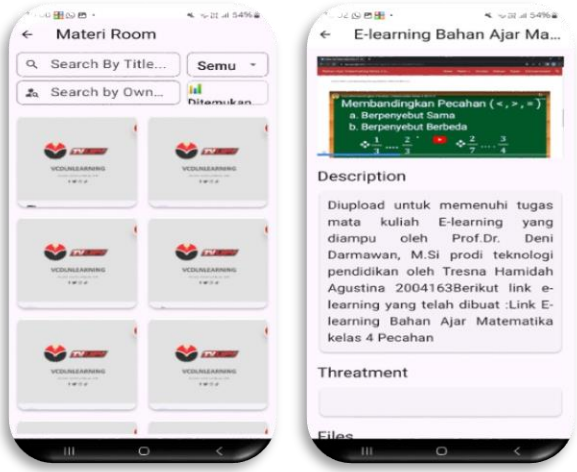

Figure-2 Interactive Multimedia with Scientifics Material in Elementary School.

The following are the results of the pretest in the experimental and control groups.

Based on Table 1, the experimental class obtained an average pretest score of 38.05 for learning interest and 44.80 for learning outcomes. Furthermore, the control class obtained an average score of 38.35 for learning interest and 45.2 for learning outcomes. The importance of conducting a pretest before administering treatment is to determine initial learning interest and initial abilities related to learning outcomes. In verification or proof-based research, a pretest is necessary to determine the magnitude of the relationship between initial and final abilities (Siregar,2023; Melani,2021). Teachers need to know students' initial abilities because they are a determining factor in the success of learning and teaching activities (Hasanudin,2020). Knowing students' initial abilities in learning is crucial so teachers can develop and adjust appropriate learning steps (Awaludin,2024).

After the pretest, treatment was administered to each group. Class 5A, the experimental group, was given Android-based interactive multimedia by installing it on their smartphones. Meanwhile, Class 5B, the control group, was given a classical PowerPoint presentation. After the treatment, a post-test was administered to determine the final abilities related to interests and learning outcomes in each group. The post-test scores are presented in Table 2.

Table 2: Comparison of Post test and Gain Values of Interest and Learning Outcomes of Classes 5A and 5B.

Value	Class/Group			
	5A (Experiment)		5B (Control)	
	Interest	Learning Outcomes	Interest	Learning Out Comes
Average	78.13	84.60	56.48	71.8
Max	90	90	65	80
Min	64	80	50	55
N-Gain	0.65 (Average)	0.71 (High)	0.29 (Lower)	0.48 (Middle)

Furthermore, a data normality test was conducted to determine whether the data distribution in both groups was normally distributed or not. The results of the normality test showed a significance value in the experimental class of 0.220 > 0.05 and the control class of 0.689 > 0.05, meaning that both groups had a normally distributed data distribution. After obtaining the data distribution in the experimental and control classes with normal distribution, a homogeneous variance test was conducted. The homogeneity test showed a significance value of 0.205 > 0.05, so Ho was accepted, meaning that the variance of the increase in learning outcomes of the experimental class and the control class was homogeneous or the same. To determine the difference in increasing student interest and learning outcomes, an average difference test was conducted using the independent sample t-test. The results of the independent sample t-test showed a significance value of 0.000 < 0.05, so Ha was accepted, meaning that there was a difference in increasing student interest in learning by using Android-based interactive multimedia with PowerPoint media in science learning. It can be concluded that the use of Android-based interactive multimedia is more effective than PowerPoint in increasing student interest in science learning. Furthermore, the results of the independent sample t-test for learning outcomes showed a significance value of 0.000 < 0.05, thus Ha was accepted, indicating a difference in learning outcomes between students using Android-based interactive multimedia and PowerPoint in science learning. It can be concluded that the use of Android-based interactive multimedia is more effective than PowerPoint in improving student learning outcomes in science learning.

Managing learning objectives plays a crucial role in achieving learning outcomes. If learning objectives are formulated before starting the learning process, it will enable a teacher to implement the learning objectives and implement learning methods appropriate to the material being taught. This will ensure a smooth and orderly learning process. Learning objectives play a strategic role in ensuring that learning is carried out effectively and systematically (Magdalena et al., 2020).

The learning outcomes examined in this study encompassed students' cognitive abilities, including remembering, understanding, and applying. Remembering is a fundamental cognitive skill that serves as a foundation for mastering other cognitive skills at higher levels. Zainudin (2023) suggests that students need to master remembering or knowledge as a fundamental cognitive skill to master higher-level skills such as understanding, applying, analysis, evaluating, and creating. In line with this opinion, the researchers examined and measured students' remembering abilities, including their ability to articulate concepts and definitions.

Based on the post-test results, the average learning outcomes of students in the experimental class learning using Android-based interactive multimedia were higher than those in the PowerPoint class. The main difference between the two groups lies in the treatment provided. Furthermore, students in the experimental class had a greater mastery of these skills at the understanding and application levels compared to those in the control class. Several studies on the application of interactive multimedia have proven effective in improving student learning outcomes. One study (Kahfi et al., 2021) found that interactive multimedia effectively increases student motivation and learning outcomes. This is in line with research findings (Darmawan et al., 2017), which suggest that interactive multimedia learning can improve English writing skills learning outcomes more effectively than conventional media.

Achievements in understanding and applying skills indicate the success of using Android-based interactive multimedia to support mastery of higher-level skills such as analysis, evaluating, and creating. Nabilah (2020) suggests that mastering the ability to understand and apply is crucial for individuals because it can determine the achievement of higher-order cognitive development. If individuals struggle to understand or apply, analysis, evaluating, and creating will be difficult.

Improved learning outcomes are directly proportional to increased interest in learning. Interest in learning is the will, desire, or preference, as well as the individual's attention to learning activities (Makmun Khairani, 2014). Student interest in learning is a key factor in learning activities and learning outcomes, which will influence overall student learning outcomes (Aprijal,2020). Indicators

emerging during learning using Android-based interactive multimedia include students actively accessing learning resources and paying attention to the material presented by the teacher. This is because the applied approach is student-centred and personalized. This contrasts with the approach applied in the control group, which was conducted in a classical and teacher-centred manner. The student-centred learning model needs to be implemented to ensure student active involvement during learning (Arif, 2023). The teacher's role should not be merely as a source of information or the sole learner who transfers knowledge to students; the teacher should act as a facilitator (Mujahida,2019).

The use of Android-based interactive multimedia during learning combines a student-centred approach. This student-centred approach emphasizes the teacher's role as a facilitator and guide for students in accessing teaching materials and learning media, thus positioning students as active learners in their learning activities. This student-centred approach aligns with the government's mandate through the curriculum, which emphasizes the importance of students constructing their own learning, with teachers acting as facilitators. The learning required is one that fosters learning capabilities, not only in the acquisition of knowledge, skills, and attitudes, but more importantly, in how those knowledge, skills, and attitudes are acquired.

The fundamental difference between Android-based interactive multimedia and PowerPoint is the limitation of compatible devices. Different devices are required for optimal functionality of the learning media features. PowerPoint can only be presented using a computer, while Android-based interactive multimedia requires a smartphone. A challenge encountered during the research was that not all students had computers, making it impossible for them to access PowerPoint anytime and anywhere. Android-based interactive multimedia, on the other hand, can be accessed by students using an Android smartphone. Most students already own smartphones, which are a valuable resource for supporting learning activities anytime and anywhere.

Android-based interactive multimedia refers to the use of handheld and mobile IT devices such as PDAs, mobile phones, laptops, and tablet PCs in learning and teaching. Therefore, most students already own mobile devices such as smartphones, which serve as valuable resources for implementing mobile learning. Furthermore, using smartphones as learning aids facilitates learning without the constraints of space and time, allowing students to learn at their own pace and ability. Darmawan (2015) also stated that the reason mobile learning is currently being developed is that it can be used anytime and anywhere (online or offline) and has broad reach.

Research conducted by Abdellah Ibrahim Mohammed Elfeky (2016) found that mobile learning had a significant effect on both students' academic achievement and conversational skills. Based on these findings, faculty members were recommended to adapt the use of mobile learning in their classes. This indicates that mobile learning has a significant impact on students' academic achievement and speaking skills.

The group of students learning using PowerPoint showed that the average post-test score (final proficiency) did not meet the learning success standard. The most fundamental difference between PowerPoint and mobile learning lies in the flexibility of the medium when used by students. Students' access to PowerPoint is limited to specific locations, namely at school, as most students lack computers or laptops. This prevents them from creating comfortable learning environments according to their preferences. Configurable learning activities according to students' preferences is a crucial supporting factor. (Hamalik,2011) states that elements related to the learning process, including the learning environment, also determine learning activities and success. A crucial aspect of classroom management is providing students with the opportunity to find learning positions that align with their interests and desires (Karwati,2015).

The effectiveness of using Android-based interactive multimedia in improving learning outcomes and learning interest compared to PowerPoint is inseparable from the role of students as learners who are adaptable and able to use smartphones. Before the treatment is applied, the teacher provides and explains how to operate it. Rowntree (1994) and Bates (1995) state that factors that influence and need to be considered in the use of media are access to media, the availability and ease of obtaining or using media. No matter how important the teaching material to be delivered and how good the delivery technique, it will be in vain if the students cannot receive it, simply because they do not have access to the media that carries the teaching material.

The low accessibility of PowerPoint compared to Android-based interactive multimedia is influenced by cultural factors or students' habits in using these media, which is a concern, requiring further

introduction and training in utilizing computer-based media. Students' habits of using smartphones are an added value for groups of students learning using mobile-based media to access learning materials. This condition is in contrast to the use of PowerPoint, which requires students to be able to use it in a limited way. This condition cannot be denied if the increase in student learning outcomes in the study group using Android-based interactive multimedia is higher than the group of students learning using PowerPoint.

5. CONCLUSION

Based on the research findings, it can be concluded that the increase in student interest and learning outcomes in the experimental group, which used Android-based interactive multimedia, was greater than in the control group, which used PowerPoint presentations. Furthermore, the independent sample t-test results showed a highly significant value, thus accepting Ha, indicating a difference in learning interest and learning outcomes between the experimental and control classes. This means that the use of Android-based interactive multimedia is more effective than PowerPoint presentations in increasing student interest and learning outcomes in science learning at Mekarmukti Elementary School. The use of Android-based interactive multimedia has advantages over PowerPoint presentations, including the inclusion of media elements (sound, images, text, animation, and hyperlinks). The implementation of learning by providing Android-based interactive multimedia to students personally is more effective in facilitating learning anytime and anywhere. Student interest in learning related to student activity in the experimental class was more dominant than in the control class, indicating high student enthusiasm for Android-based interactive multimedia.

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