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The Development of Android-Based Interactive Multimedia for High School Students

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ABSTRACT
The application of technology in the field of learning is believed to be able to improve students learning abilities. One of the uses of technology in the digital era today is a smartphone with the Android operating system as a learning multimedia. Learning activities that use multimedia have a positive effect on student learning outcomes. This study aims to determine the feasibility of android-based interactive multimedia on the buffer solution material based on the criteria of the National Education Standards Agency (Badan Standar Nasional Pendidikan, BSNP) and the effectiveness of student learning outcomes. This type of research uses the Research and Development (R & D) method with the stages of developing the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation). Data collection instruments consisted of media validation sheets based on BSNP criteria and learning achievement test instruments. Sources of data in this study were 4 expert validators and students of class XI senior high school totaling 50 students using purposive sampling data collection technique. The results showed that the multimedia validation test by the expert validator stated that interactive multimedia based on android is valid with an average value of 3.74 from a maximum scale of 4 which means it is feasible to use and does not need to be revised. Furthermore, the results of the effectiveness test show that the learning outcomes of students who are taught with Android-based interactive multimedia are better than students who are taught with multimedia sourced from the internet. Based on the results of validation and effectiveness shows that interactive multimedia based on Android is feasible to be applied as a learning media buffer solution for high school students.

Keywords: *interactive multimedia, android, student learning outcomes, buffer solutions*

1. INTRODUCTION

Education is a bridge from the realities of life that students will face in the 21st century so that the education system must prepare to learn patterns that are appropriate to the time students will face [1]. In the digital era, technology and information are developing very rapidly and have entered the world of education. A good education can adapt and apply technological developments in the learning process [2].

One of the chemical materials taught in class XI SMA is a buffer solution. The characteristics of this material are abstract, conceptual understanding, applicative, and mathematical operations. Based on the results of observations that have been made, it is obtained data that students' chemistry learning outcomes are not optimal, it can be seen from the learning outcomes obtained by students who have not reached the Minimum Completion Criteria (KKM) set by the teacher. This is due to the boring learning atmosphere, the tense atmosphere during learning, the many calculations, so that students have difficulty understanding the concepts in chemistry lessons, especially the buffer solution material.

The supporting factor for the learning process in the 2013 curriculum is the use of technology-based learning media. The development of multimedia technology has a positive impact on changing the way of learning by obtaining, adjusting, and using the information in the learning process [3]. The application of technology in the field of learning is believed to improve students' learning abilities [4]. Along with technological developments, it requires teachers to be able to use technology in creating and developing multimedia learning. Learning activities that use multimedia have a positive effect on student learning outcomes [5]. In the

learning process, not all teachers use technology as a medium of learning. This is due to the limited learning time available, the limitations of teachers in using technology, and the lack of available technology-based learning applications. So that the teacher only uses the facilities available in the school such as textbooks and student worksheets.

In learning chemistry, basic concepts are very important for students to master. So that the material provided can be conveyed in the learning process and can stimulate the thinking, feeling, attention, and willingness of students, multimedia can be used [6]. The application of multimedia learning in learning activities is expected to streamline the learning process, achieve learning objectives so that it can improve student learning achievement, and motivate them to subject matter [7]. Learning media has become a necessity in the learning process. The use of instructional media can overcome common obstacles that often occur in the learning process, such as limited learning hours in class, boredom in the learning process, and the complexity of delivering abstract material [8].

The importance of considering interactive design in developing multimedia material into a learning environment, because the core of any digital multimedia development is interactive [9-10]. Interactive in the context of multimedia computer-based learning is a reciprocal activity between students and multimedia learning systems, where student reactions depend on system reactions and vice versa. [11]. Interactive multimedia allows users to interact with various combinations of media such as text, graphics, animation, audio. , videos, and video games [12].So that the use of interactive multimedia in learning can improve learning outcomes [13].

Science learning becomes more lively and follows technological developments by using smartphones, this is very well done to support science learning [14]. The operating system used on smartphones today is generally the Android operating system. Android-based learning can be used as a source of independent learning as well as learning media that is free to access anytime and anywhere users are without being limited by space and time [15]. Smartphone-based media is flexible and can be used repeatedly as desired by students. Repetitive learning with high frequency can improve student achievement. So that the use of android-based media can increase student motivation and learning outcomes [16].

The innovation made to improve student learning outcomes in the learning process is to develop interactive multimedia based on Android with features that can provide activity and spur student curiosity in learning chemistry. Learning multimedia in the form of an educational application on mobile phones (android) is effective as a learning medium [17] so that it can make the learning process more interesting [18], flexible [19], increases student learning concentration, and helps student understanding so that it can have a positive influence on student learning outcomes [20, 21].

2. METHODS

This study uses an R & D (Research and Development) approach with the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) model. These steps include (1) Analysis (analyzing the feasibility of existing multimedia), (2) Design (understanding and compiling the initial product or product design), (3) Development (developing a product design), (4) Implementation (using new learning media that have been developed in real learning in class), (5) Evaluation (measuring the final competency of learning media). The stages of developing multimedia interactive learning chemistry based on android using android studio version 3.5 Integrated Development Environment (IDE) with the Java programming language on the buffer solution material are illustrated in Figure. 1.

The research instrument used to collect data was a media validation sheet based on BSNP criteria and an objective test of learning outcomes. This research was conducted in the MAN 2 Medan Model. The population in this study were all students of class XI MAN 2 Medan Model for the 2019/2020 school year. The sample was selected using a purposive sampling technique, namely, 25 students were taken for classes taught with Android-based interactive multimedia that had been developed (Experiment I) and 25 students for classes taught with multimedia sourced from the internet (Experiment II).

Data were analyzed descriptively based on the average score of learning outcomes, then inferential statistical tests were carried out with a t-test. Before the t-test is carried out, the prerequisite test is carried out first, namely the normality test and the homogeneity test. The results of testing the learning outcome data for each sample from the population were normally distributed and homogeneous at the time ($p > 0.05$). Then proceed to the parametric analysis of hypothesis testing using the independent sample T-test with the SPSS 22 for the Windows program.

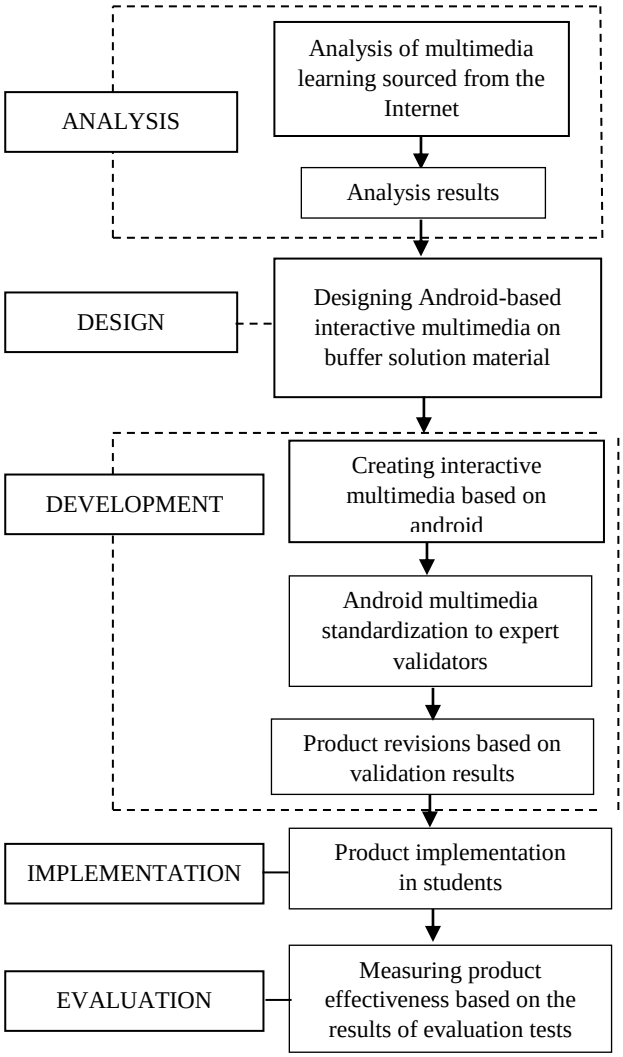


Figure 1 Research Design

3. RESULT AND DISCUSSION

In this study, the development of interactive multimedia learning based on android buffer solution material has been carried out. Before developing multimedia, first, an analysis of multimedia learning circulating on the internet is carried out with the buffer solution material. This analysis was conducted to determine the feasibility of learning multimedia circulating on the internet and interactive multimedia based on android that has been developed. The questionnaire used to determine the feasibility of multimedia being developed was the BSNP (National Education Standards Agency) questionnaire. The questionnaire consists of 3 eligibility criteria, namely content feasibility, language eligibility, and presentation feasibility. The average value of each aspect will show the level of validity of the interactive multimedia being developed. The eligibility criteria for the developed Android-based interactive multimedia are presented in Table 1.

Table 1. Eligibility Criteria

Average	Eligibility Criteria
3,26 – 4,00	Very Feasible
2,51 – 3,25	Feasible
1,76 – 2,50	Less Feasible
1,00 – 1,75	Not Feasible

3.1. Analysis of Existing Multimedia on the Internet

At this stage, the researchers analyzed multimedia learning circulating on the internet, namely multimedia sourced from Pustekkom on buffer solution material for class XI SMA students. This is done to determine the quality of multimedia learning sourced from Pustekkom, whether it is appropriate, necessary / not necessary to be developed or not suitable for use in the learning process. This analysis was carried out to obtain multimedia learning by the 2013 curriculum.

Based on the analysis conducted on multimedia learning sourced from Pustekkom. So multimedia is said to be suitable for use but it still needs to be further developed in multimedia because there are still deficiencies, especially in the content and presentation of multimedia as presented in Table 2.

Table 2. Results Of Multimedia Analysis Circulating On The Internet

No	Weakness	Solution of Development
1	Does not include indicators and learning objectives	Include indicators and learning objectives derived from the basic competencies of the buffer solution material
2	The material presented does not support overall material that is by the basic competency of the buffer solution material	Presenting the submatrix role of buffer solution in life so that the material in the media by basic competencies.
3	Multimedia only contains material and evaluation questions in the form of multiple choices	Providing innovations related to interactive features in multimedia to increase student activity and curiosity in learning activities
4	The exercises in multimedia are only multiple choices	Combine various types of interactive exercises to provide interesting and not boring learning activities

5	There are no instructions for using multimedia	Include instructions for using icons/buttons on multimedia and multimedia info
6	There is no audio in the form of response related to the answer to the exercise and accompaniment music on multimedia	Provide innovation in the form of the audio application in multimedia
7	There are no learning videos that can support learning activities	Showing learning videos to make it easier for students to understand the material

Table 2 shows that learning multimedia sourced from Pustekkom still has shortcomings in multimedia. So it is necessary to revise and further develop multimedia content sourced from Pustekkom, especially in the aspects of content and presentation so that multimedia learning can be used in chemistry learning and provide interesting and innovative learning for students.

3.2. Android-Based Interactive Multimedia on Buffer Solution Material

The process of making Android-based interactive multimedia on the buffer solution material is carried out based on the storyboard and flowchart design stages. Based on the results of the multimedia analysis, researchers have developed multimedia learning. Learning multimedia was developed using the Android Studio version 3.5 Integrated Development Environment (IDE) with Java programming language on the buffer solution material. The following is a visualization of android-based interactive multimedia on the buffer solution material shown in Figure 2.

3.2.1. Instructions for Using Multimedia

Instructions for using this learning application are in the form of an icon/navigation button which contains an explanation regarding the contents of each menu icon contained in the application as shown in Figure. 2a. Instructions for use will appear automatically when the user for the first time using this learning application. The goal is to make it easier for users to operate the application.

3.2.2. Menu Material of Buffer Solution

This material menu displays topics related to buffer solutions which consist of introductory theory, understanding & working principles of buffer solutions, components of buffer solutions, and the role of buffer solutions in the body & daily life as shown in Figure. 2b.

3.2.3. Interactive Exercise Menu

This menu presents three different exercises for the buffer solution material in their presentation as shown in Figure. 2c. Exercise I presents the drag and drop test model; exercise II with the test description model completes the blanks, and exercise III with a multiple-choice test model

3.2.4. Buffer experiments

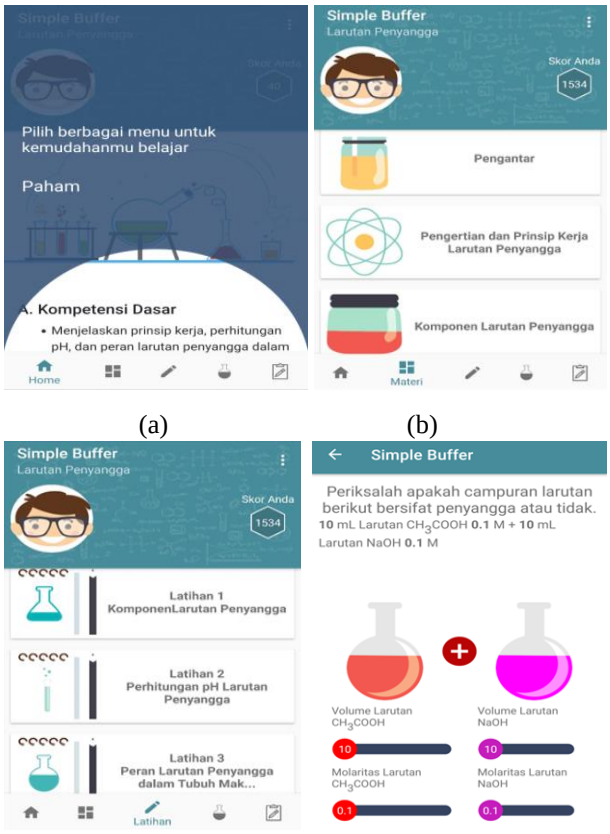
The experimental buffer menu presents an experimental simulation of a buffer solution in terms of mixing acid and base solutions with certain concentrations and volumes as shown in Figure. 2d. Aims to find out the properties of the solution whether the buffer solution or solution is not a buffer.

3.2.5. Tryout menu

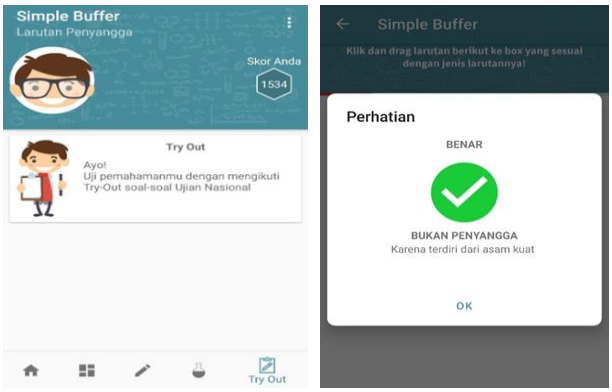
The tryout menu presents 10 multiple choice questions regarding the buffer solution material. This tryout aims to evaluate users/students after the learning process of the buffer solution is complete as shown in Figure. 2e.

3.2.6. Interactive response

The interactive response is giving feedback on answers to exercises and tryouts that have been done as shown in Figure. 2f. So that users/students can find out the correct answer to each question displayed.



(c) (d)



(e) (f)

Figure 2.Interactive Multimedia Display Based on Android on Buffer Solution Material; (a) instructions for use; (b) menu material; (c) training menu; (d) experimental buffers; (e) tryout; and (f) interactive responses

After the product has been developed, the media's feasibility test is carried out by an expert validator using BSNP standard instruments. The results of the feasibility test for interactive multimedia based on android on buffer solution material based on BSNP standards by expert validators obtained the content feasibility of 3.74 (very feasible), 3.72 language feasibility (very feasible), and 3.75 presentation feasibility (very feasible). The results of the feasibility test for Android-based interactive multimedia can be seen in Figure. 3.

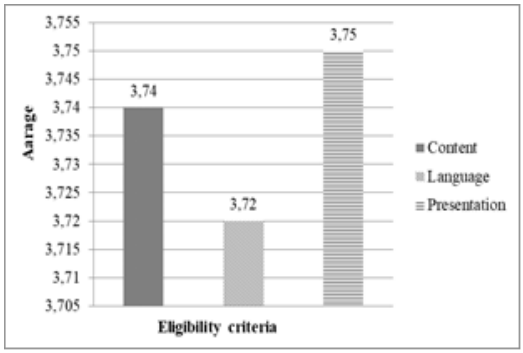


Figure 3. Feasibility Test Results for Android-Based Interactive Multimedia on Buffer Solution Material

Based on the Figure3.shows that the results of the interactive multimedia analysis based on android based on the BSNP instrument have an average, namely: (1) the content feasibility test of 3.74 (very feasible); (2) language feasibility test of 3.72 (very feasible); and (3) presentation feasibility test of 3.75 (very feasible). Thus overall the results of this interactive multimedia analysis have an average value of 3.74 which belongs to the very feasible category. These results indicate that android-based interactive multimedia on buffer solution material is feasible for use in learning chemistry as a support for student learning resources in studying chemistry on the topic of buffer solutions [7] [22].

3.3. The Effectiveness of Using Android-Based Interactive Multimedia in the Learning Process

Based on the data on student learning outcomes obtained from the results of the implementation of learning activities that have been carried out in the study and after being tabulated, the average data and standard deviation of the pretest and posttest scores from both experimental class 1 and experiment 2 were obtained as in Table 3.

Table 3. Pretest and Posttest Data

Group	Average Value		Standard Deviation	
	Pre-test	Post-test	Pre-test	Post-test
Experiment 1	35,00	88,00	9,566	8,539
Experiment 2	35,80	82,60	8,622	6,633

Based on the data on the students' pretest and posttest scores, the value of student learning outcomes improvement is obtained. The increase in student learning outcomes (N-gain) can be seen from the difference in the average pretest and posttest scores. The results of the student's average N-gain score can be seen in Table 4.

Table 4. Difference N-Gain

Group	Average Value N-gain	Standard Deviation
Experiment 1	0,83	0,11778
Experiment 2	0,73	0,08789

Based on Table 4 it shows that the N-gain of students on the buffer solution material for the experimental class I obtained an average of 0.83 while for the experimental class II an average of 0.73 was obtained. The improvement of student learning outcomes is visualized in Figure. 4.

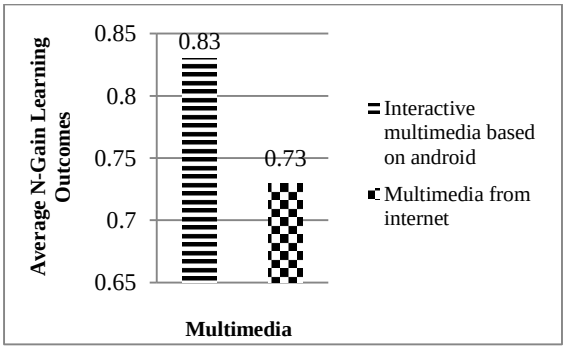


Figure 4. Graph of Average Student Learning Outcomes Improvement

Based on the Figure 4 it can be concluded that the improvement in learning outcomes taught with Android-based interactive multimedia is higher than those taught with multimedia sourced from the internet.

From the table of the distribution improvement in learning outcomes (N-gain), both samples are normally distributed and the data is homogeneous, then hypothesis testing is carried out. This test was conducted to support success of the chemistry learning media developed in improving student achievement by using the independent sample t-test. The results of hypothesis testing are presented in Table 5.

Table 5. Results of Hypothesis Test

Hypothesis	Sig. (2-tailed)	α	Conclusion
There is a difference in the improvement of student learning outcomes taught by interactive multimedia based on android and multimedia sourced from the internet on the buffer solution material.	0,003	0,05	H_a accepted

Based on the results of hypothesis testing presented in Table 5, the sig value (0.003) < α (0.05) is obtained, so H_0 is rejected and H_a is accepted. So that there is a difference in the improvement of student learning outcomes taught with android-based interactive multimedia and multimedia sourced from the internet on the buffer solution material.

The difference in the increase in student learning outcomes can be seen based on the average N-gain score of students in Table 4 which shows that students who were taught with Android-based interactive multimedia obtained an average score of 0.83 higher than students who were taught with multimedia sourced from internet with an average value of 0.73. Thus it can be concluded that the increase in learning outcomes taught with android-based interactive multimedia is higher than those taught with multimedia sourced from the internet on the buffer solution material.

This shows that Android-based interactive multimedia is better at improving student learning outcomes because this multimedia is equipped with material that is by the learning objectives to be achieved, learning videos, interactive exercises, tryouts and buffer experiments. This makes it easier for students to understand learning material through applications on their respective smartphones, improve their understanding of concepts, and provide interesting learning for students [23-25].

Learning using an Android smartphone makes learning situations virtually so students feel that the learning process is not limited by time and space because the mobile learning application can be used anywhere and anytime [26-27]. Ahmar&Rahman's research [28] states that on average 90.32% of students feel faster in understanding material and practical exercises when using Android-based teaching materials and 100% of students feel more ready to face the subject matter. Based on the research of Muchtar [29] and Yuliani [30], it is stated that multimedia apps based on android in chemistry learning are effective as a medium of learning in improving student learning outcomes.

Smartphone learning allows educators and students to go beyond traditional school spaces and communication tools give educators and students increased flexibility and offer new interaction opportunities. The benefits of learning using Android-based multimedia are as follows: (a) Access can be made anytime and anywhere to content; (b) Supporting distance learning; (c) make learning centered on students; (d) Excellent for timely training or content review; (e) Can be used more effectively with people of different abilities; (f) Can increase the interaction between students and teachers; (g) Reducing cultural and communication barriers between teachers and students by using communication channels preferred by students [31].

4. CONCLUSION

Based on the results of data analysis and discussion of the research carried out, it can be concluded: (1) interactive multimedia based on android on the material of the buffer solution that has been developed obtained an average value of 3.74 which is in the category of feasible for use in chemistry learning and does not need to be revised; (2) the effectiveness test show that the learning outcomes of students who are taught with Android-based interactive multimedia are better than students who are taught with multimedia sourced from the internet. The results of validation and the effectiveness of improving learning outcomes indicate that android-based interactive multimedia is feasible to be applied as a medium in the material of buffer solutions for high school students.

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