DEVELOPMENT OF INTERACTIVE TEACHING MATERIALS BASED ON ANDROID APPLICATION FOR ELEMENTARY SCHOOL STUDENTS

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Abstract: This research aims to produce a prototype of interactive teaching materials based on android applications effectively used in thematic learning in Elementary School. This development research uses the DDD-E model with four stages of development which include: (1) decide, (2) design, (3) develop, and (4) evaluate. The products developed are divided into six applications that focus on the sub-theme of Environmental Conservation. Based on the test results, the obtained paired sample test results had a significance value of 0.001, which is less than 0.05. It can be interpreted that there is a significant difference between student learning outcomes before and after using interactive teaching material. The effectiveness of interactive teaching materials can be seen from the results of the N-Gain test with an average gain score of 0.6, which means the level of effectiveness of interactive teaching materials is in the medium category.

Keywords: interactive teaching materials; android application; elementary school

INTRODUCTION

Learning is not only an activity carried out by the teacher to explain the material to students and continued by giving assignments, but learning also includes all interactions between students, teachers, and learning resources. The teacher plays a very important role as a facilitator in developing student potential during the learning process (Bjuland & Helgevold, 2018; Thomas & Thorpe, 2019). Learning can be achieved optimally according to planned goals and using appropriate teaching materials beforehand.

Teaching materials are a collection of systematically arranged materials and contain teaching materials to create an adequate learning environment and atmosphere for use by students (Prastowo, 2013). In the current implementation of the 2013 curriculum, teacher books and student books are available as one of the teaching materials that can be used in learning. Using teaching

materials that are not in accordance with the criteria and conditions of learning results in the emergence of problems during the learning process. Therefore, adjusting teaching materials to the curriculum and student needs is an important factor that must be considered in developing teaching material (Nasrul, 2018).

Based on the current learning conditions, learning is taking place online. The teaching materials will certainly be different from face-to-face learning and must be adapted to current learning conditions. The current coronavirus outbreak has a major impact on the world of education, especially in the school environment (Kusumadewi et al., 2020). So, directly or indirectly, the epidemic's impact was also felt at every level of education in Indonesia.

Almost all levels of education in Indonesia carry out online-based learning. Online learning is carried out with the help of software or electronics (Smaldino et al., 2011). Teachers can use the development of science and technology, which is currently developing rapidly, to develop teaching materials when learning is being carried out online (Crowley, 2017; Mulenga & Marbán, 2020; Qian et al., 2018). Technology-based teaching materials include interactive CDs, radio and television broadcasts, films, interactive videos, and multimedia. Interactive teaching materials are effectively used in learning because they are interactive and are supported by animation, audio, images, videos, texts, and interrelated programming to allow two-way or reciprocal interactions between users and teaching materials (Prastowo, 2015).

Android devices are a form of technology that can help carry out online learning that is carried out remotely, thus allowing interactive learning to occur without being limited by space and time. The use of android devices in learning can make it easy for students to access material from anywhere (Yahya, 2016). This option can make it easy for students to access the material often to make students more aware of the material being studied.

According to the results of an interview with the 5th-grade homeroom teacher at SDN Dadaprejo 2 Batu, the school is currently conducting online learning. Several problems arise during online learning, one of which uses teaching materials that are not yet interactive. The teaching materials used in grade 5 of SDN Dadaprejo 2 Batu tend to be monotonous and fixated on the use of student books displayed during online learning through the Skype application. This problem causes students who like to interact directly with teaching materials to feel bored and less enthusiastic during learning.

There are other problems during online learning, where students find it difficult to concretize abstract concepts because the teacher only presents material through practice questions from student books. Teachers find it difficult to provide concrete explanations when learning is done online without face-to-face due to limitations in teaching materials. It is possible to design teaching materials that utilize technology. This possibility is because all 5th-grade students at SDN

Dadaprejo 2 Batu have android devices that can be used to access learning. Teachers also have android devices and laptops that can be used to design or develop teaching materials that are more creative and innovative and follow current learning conditions.

It is necessary to develop interactive teaching materials based on applications on Android to support the implementation of online learning. Through these interactive teaching materials, students will be able to interact directly with teaching materials even though learning is carried out remotely without being constrained by space and time. This statement aligns with the research entitled Development of Flash-Based E-Module Interactive Teaching Materials for Grade V Elementary School, which states that flash-based interactive teaching materials are effective for learning (Nurida, 2017). The flash teaching materials developed are similar to Android applications, although in different file formats.

The potential for the availability of supporting facilities to develop teaching materials based on android applications at SDN Dadaprejo 2 Batu is the basis for consideration of researchers conducting research and development at the school. Based on the explanation above, the researcher intends to conduct research entitled "Development of Interactive Teaching Materials Based on Android Applications for Elementary School Students." This research could be a solution or alternative in creating teaching materials suitable for students' needs and are effectively used in thematic learning in elementary school.

METHOD

This research is included in research development or Research and Development (R & R&D). The model used in this research and development is the model DDD-E. Model DDD-E has four stages or steps, among others: (1) decide, (2) design, (3) develop, and (4) evaluate. This model is usually used to develop multimedia (Ivers & Barron, 2002). In line with this opinion, researchers are interested in using this model because of the interactive teaching materials. The materials that will be developed are included in the type of multimedia product intended to provide innovation, improvement, and increase the quality of student learning amid the limitations of learning online that is currently being implemented.

The types of data used in this study are qualitative and quantitative data. Quantitative data were obtained from the test results (pretest and post-test) of students to determine the product's effectiveness in learning. Qualitative data were obtained from providing suggestions and comments from experts (material experts, media experts, and learning experts) and users (homeroom teachers and students). Effectiveness data were obtained by calculating the paired sample test and the N-Gain test, where the test was carried out through one group pretest and post-

test. Before calculating the paired-sample t-test, the normality test and homogeneity were carried out on the data pretest and post-test with the help of SPSS.

The normality test was carried out using the technique Shapiro Wilk because the number of samples was less than 50 data. The basis for decision-making in the normality test is seen through the significance value. When sig. (significance) > 0.05, then the data is normally distributed. Meanwhile, if sig. (significance) < 0.05, then the data is not normally distributed. The homogeneity test was calculated using one-way ANOVA with the help of SPSS. The basis for decision-making in the homogeneity test of normality is seen through the significance value. When sig. (significance) > 0.05, then the variance of the data is homogeneous. Meanwhile, when sig. (significance) < 0.05, then the data variance is not homogeneous.

The calculation of the paired sample test was carried out using SPSS. Decision-making is guided by the significance value generated through SPSS. If the probability value is <0.05, there is a significant difference between the pretest and post-test results, meaning interactive teaching materials improve student learning outcomes. If the probability value is > 0.05, there is no significant difference between the pretest and post-test results, meaning interactive teaching materials do not improve student learning outcomes.

The N-Gain test is used to measure the effectiveness of product implementation in learning. The N-Gain test is also used to determine students' understanding after learning. Changes in students' level of understanding can be seen from the results of the pretest and post-test marked by a score gain to determine the effectiveness of the improvement. Calculation of N-Gain with an ideal score of 100 using the following formula.

The interpretation of the effectiveness of N-Gain can be seen in Table 1 below (Hake, 1999).

Table 1. Criteria Gain Score

Gain Score	Interpretation
$g > 0.7$	High
$0.3 < g \leq 0.7$	Medium
$g \leq 0.3$	Low

RESULT AND DISCUSSION

Researchers have developed the development of teaching materials based on Android applications through four stages or steps, including: (1) decide, (2) design, (3) develop, and (4) evaluate.

Stage Decide

The researcher chose theme 8, The Environment of Our Friends, and the sub-theme 3, Efforts to Preserve the Environment, because the material's content related to nature and the environment around students. This theme is also more appropriate when it is delivered using technology so that examples of pictures, illustrations, videos, and audio can be used in online learning. In line with

this, interactive learning multimedia is feasible to use as a medium that makes it easier for students to learn about the material for the Environmental Conservation Business sub-theme (Cahya, 2016).

After determining the material and learning objectives, the researcher continued to determine the students' ability to use or operate technology such as android devices from the 5th-grade teacher at SDN Dadaprejo 2 Batu. A person must have and master the tools to work, especially those related to the mastery of information, communication, and technology. Without information, communication, and technology, it will be difficult for someone to develop their work (Prayitno, 2013). Grade 5 students at SDN Dadaprejo 2 are already familiar with learning online by using the help of applications on android devices such as WhatsApp and Skype, which they have done during the previous semester. This result can be seen in the student's skills during online learning, which is carried out through the help of the WhatsApp and Skype Applications. All students also have their own Android devices, although some use their parents' devices.

Stage Design

In the second stage, the researcher makes product design to compose an outline, flowchart, interface design, and storyboarding. The researcher's design is influential in developing the product that will be realized. Researchers adjust the design with interactive multimedia design. The addition can see these navigation buttons interconnected between one component and another. The addition of images, audio, and video supports interaction between the product and the user, thus making the product an interactive multimedia product. In line with this, multimedia can affect the senses and interests of users because multimedia combines audio, visual, and movement (Adi et al., 2021; Krüger & Bodemer, 2022; Mashari & S, 2021). Combining these components can increase the interaction between users and multimedia products to effectively use them in learning (Munir, 2012).
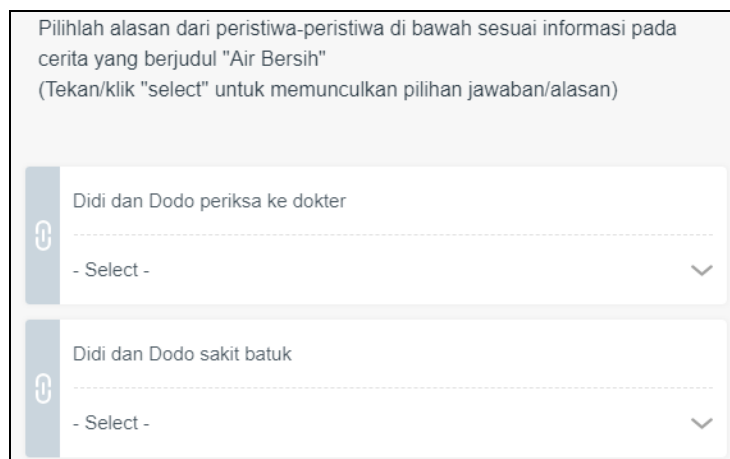
Stage Develop

In the third stage, the researcher realizes the design that has been designed into an initial product with the help of Microsoft PowerPoint software. Microsoft PowerPoint software is due to its simple operation with quite complete features and supports incorporating components in developing interactive teaching materials. After the merging process is complete, the researcher continues to publish the initial product through the software iSpring. The initial product output is in HTML format, ready to be converted into format APK via the website and into .apk software. In addition to the format .apk, the researcher also makes the product in a website link using HTML format. Then with services hosting, researchers make it in the form of a website link so that the media can be used on various types of android devices and PCs in various situations, both online learning and face-to-face learning at school. In line with this, anyone, anytime and anywhere, interactive multimedia must be used (Munir, 2012). This statement explains that the product

developed must be adapted to the situation and environmental conditions and students during learning.

Stage Evaluate

After the product has been developed and realized, the researcher continues to carry out the assessment or evaluation stage. The evaluation stage is divided into two stages: one-on-one assessment and small group assessment. In the one-on-one assessment stage, the researcher piloted the initial product to three experts, namely, material experts, media experts, and learning experts, to get useful product improvement and refinement feedback. In line with this, one-on-one assessments of students and experts are carried out to perfect and improve the products developed (Fadillah & Lestari, 2016). One-on-one assessments get information about errors and product completeness obtained from students and experts in the field of study to make improvements and product improvements (Sadiman et al., 2003).
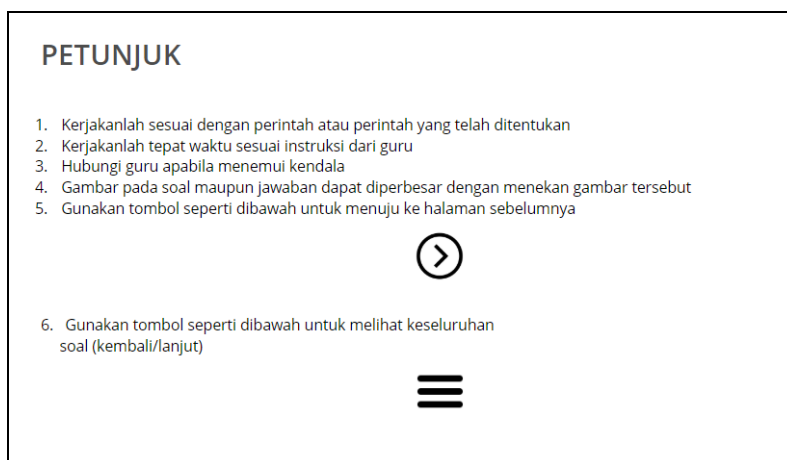

Figure 1. Instructions for working questions

Figure 2. Instructions for practice questions

One-One Assessment Results

Based on the assessment results by the three students, there were improvements to the clarity of instructions and the addition of instructions in practice questions so that students could easily understand them. Students are confused about how to answer some questions. Therefore, the researcher revised by adding ways to answer the questions, as shown in Figure 1.

Based on the learning expert assessment results, several improvements included clarifying skill competencies in practice questions, adding actual questions, rearranging overlapping text and images, adding instructions for some difficult questions for students to understand, and adding navigation button instructions. The navigation buttons are a built-in feature in the software iSpring used to create practice questions. Based on this, the researchers made improvements by adding operating instructions for practice questions, as is shown in Figure 2.

Based on the assessment of material experts, there were several improvements, including clarifying attitude competence, adding non-fiction text material, adding audio illustrations, completing product identity, clarifying the purpose needs to be clarified, and improvements to some lettering. Some of the improvements are shown in Figure 3 and Figure 4.

The display in Figure 4 is a revised view on the product opening page. Before revision, the identity on the opening page did not yet display a description of the semester, class, theme, and learning. Figure 4 depicts the view after the revision, displaying the complete identity.
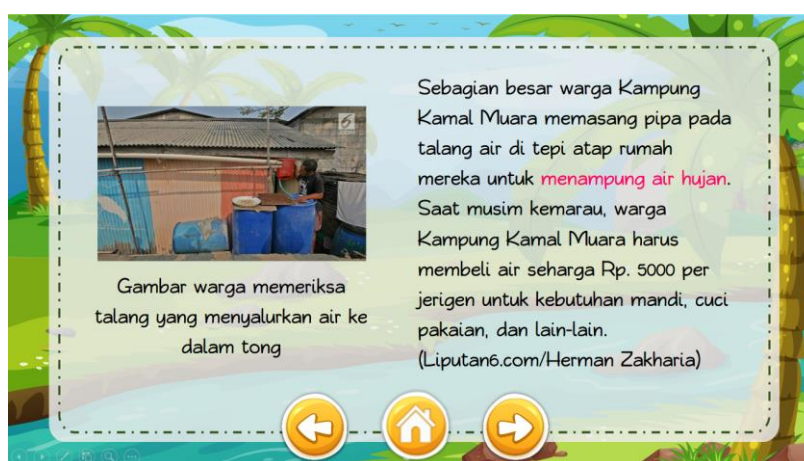

Figure 3. Non-Fiction Material

The display in Figure 3 is an example of adding non-fiction text. The addition of non-fiction texts, apart from being a competency requirement, is also needed to provide examples of discourse in the material presented on the product so that students can get real examples.

Figure 4. Product Identity

Based on the assessment of media experts, there were several improvements, including the emphasis on keywords, adding descriptions to images, adding product output in the form of website links, adding instructions for use, and adding communicative language. Some of the improvement results are shown in Figure 5 and Figure 6.

Figure 5. One Page Display

In Figure 5, the researcher made revisions by emphasizing keywords in each text. This result aligns with the signalling principle, where a text must be presented with signs to help students focus on the main information in the text (Schneider et al., 2018). In Figure 5, it can also be seen that the researcher added information under each picture. This result follows the principle of spatial continuity, where students will be able to learn better when related words and images are paired close together.
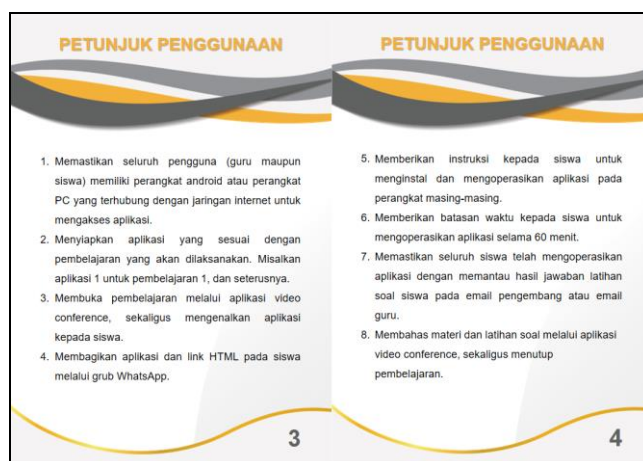
Figure 6. Instructions for Product Use

Instructions for using the product by teachers or users need to be added so that the product can be used properly during learning. Researchers added instructions for use separately with the product in PDF format. The user manual explains the product specifications and an explanation of the instructions for use, as shown in Figure 6. The product specifications explain the product components, product types, and terms of product use. The user manual section contains steps for using the product adapted to learning online.

Table 2. Results of Pretest and Posttest

No	Student's Name	Pretest Result	Posttest Result
1	S-1	40	70
2	S-2	60	85
3	S-3	65	95
4	S-4	80	85
5	S-5	75	90
6	S-6	75	85
7	S-7	80	100
8	S-8	85	90
9	S-9	85	90
10	S-10	85	90
11	S-11	95	100
12	S-12	90	100

Small-Group Assessment Results

The first meeting began with implementing a pretest to measure the ability and knowledge of students regarding the material to be studied in the sub-theme of Environmental Preservation Efforts. In the small-group assessment stage, the researcher, with the help of the homeroom teacher-tested twelve students to obtain data on the effectiveness of the product and useful feedback from users, namely homeroom teachers and students. Like the last meeting, the sixth meeting was held post-test to determine the extent to which the objectives could be achieved and to measure the product's success. The results of the pretest and post-test of grade 5 students at SDN Dadaprejo 2 can be seen in Table 2.

Table 3. Normality Test Results Through SPSS

	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistic	*Df*	*Sig.*	*Statistic*	*df*	*Sig.*
Pretest	.217	12	.124	.892	12	.126
Posttest	.196	12	.200*	.879	12	.085

The results of the pretest and post-test were tested for normality using the technique Shapiro Wilk with the help of SPSS. The normality test was carried out as a requirement for parametric calculations to determine the conclusions of the paired sample test. The result of the normality pretest with a significance value of 0.126 means that the value is more than 0.05. So, the data pretest was normally distributed. The normality results in a post-test with a significance value of 0.085, which means the value is more than 0.05. So, the data post-test is normally distributed. In conclusion, the pretest and post-test data are normally distributed so that parametric statistical analysis can be carried out, namely the paired sample test. The results of the calculation of the normality test can be seen in Table 3.

The pretest and post-test data were then tested for homogeneity with one-way ANOVA on SPSS. The homogeneity results were obtained during the pretest and post-test with a significance value of 0.128, which means the value is more than 0.05. So, the data pretest and post-test are homogeneous. The results of the homogeneity test calculation can be seen in Table 4.

Table 4. Results of Homogeneity Test Through SPSS

Levene Statistic	Df1	Df2	Sig.
2.495	1	22	.128

Effectiveness data were obtained by calculating the level of significant difference between the pretest and post-test of students in the paired sample test and continued calculating the level of effectiveness of interactive teaching materials using the N-Gain test. The paired sample test was carried out using SPSS.

Table 5. Paired Sample Test Results Through SPSS

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	*Std. Deviation*	*Std. Error Mean*	*95% Confidence Interval of the difference*				
				Lower	*Upper*			
Pair 1 (pretest-posttest)	-13.750	10.028	2.895	-20.122	-7.378	-4.750	11	.001

The significance value of the paired sample test results is 0.001, which means less than 0.05. So, it can be interpreted that there is a significant difference between the results of the pretest and post-test. In other words, interactive teaching materials improve student learning outcomes. This is in line with the study that shows the improvements of students' learning outcomes (Asrowi et al.,

2019; Rachmadtullah et al., 2018; Vercellotti, 2018). The results of the homogeneity test calculation can be seen in Table 5. To determine the level of effectiveness of the product, then tested the effectiveness of the test N-Gain. The results of the calculation of the N-Gain test can be seen in Table 6.

Table 6. Test Results N-Gain

No	Student's Name	Pretest Results	Posttest Results	Gain Score
1	S-1	40	70	0.5
2	S-2	60	85	0.63
3	S-3	65	95	0.86
4	S-4	80	85	0.25
5	S-5	75	90	0.6
6	S-6	75	85	0.4
7	S-7	80	100	1
8	S-8	85	90	0.33
9	S-9	85	90	0.33
10	S-10	85	90	0.33
11	S-11	95	100	1
12	S-12	90	100	1
Average Gain Score				0.6

In this small group assessment, questionnaires were distributed to users, namely teachers and students, to find out the user's responses to the product and find deficiencies in the product. The teacher considered that installation instructions were needed because some students seemed confused about installing the application at the beginning of the meeting. Therefore, the researcher added installation instructions to the product user manual. Meanwhile, overall aspects showed a positive response based on student assessments, although some students had certain obstacles. The problems faced by students in operating the application lie in individual abilities and problems in the application system, so researchers feel that there is no need for improvements to the product.

Based on the results of the assessment and testing of the product, the developed Android-based interactive teaching materials are effectively used in learning to improve student learning outcomes. In line with these results, android-based teaching materials were proven to improve student learning outcomes (Aprelliyanto, 2019). Other research also shows that the flash-based teaching materials that she developed have proven effective in learning (Nurida, 2017).

CONCLUSION AND RECOMMENDATION
Conclusion

Based on the results of the analysis and discussion regarding the research and development of interactive teaching materials based on android applications for grade 5 elementary school students, it can be concluded that the product has been repaired and refined based on the assessments of learning experts, material experts, media experts, and users. The product has been proven to be effective in thematic learning in grade 5, as evidenced by the results of the paired sample test,

which shows that there are differences in student learning outcomes before and after using the product. The level of effectiveness is included in the moderate category based on the results of the N-Gain test. The products developed are divided into six applications that focus on the sub-theme of Environmental Conservation.

Recommendation

Based on the research and development findings that have been described, the researcher proposes several suggestions. For teachers, mentoring and providing motivation to students in using interactive teaching materials is very important so that students can learn independently. The school also needs to support innovation in developing interactive multimedia-based interactive teaching materials by meeting learning support facilities and infrastructure availability. Considering that the implementation of this research is still limited to several factors, it is necessary to conduct other similar studies on a wider stage with a much larger and wider sample to produce perfect and useful findings.

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