Android-Based Interactive Learning Multimedia to Improve Reading Literacy in High Schools

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A B S T R A K

Literasi Membaca merupakan kemampuan yang paling pertama dikuasai agar bisa menguasai literasi yang lain. Kemampuan literasi membaca siswa masih tergolong rendah menurut PISA tahun 2018. Perlu adanya usaha untuk meningkatkan kemampuan literasi membaca, salah satunya adalah mengembangkan Platform Literasi. Tujuan penelitian ini adalah mengembangkan multimedia pembelajaran untuk meningkatkan literasi membaca. Untuk mencapai tujuan penelitian tersebut digunakan metode Research and Development (R&D) dengan model pengembangan Dick & Carey. Penelitian ini dilakukan di sekolah menengah atas dengan partisipan 30 siswa. Multimedia divalidasi oleh ahli materi, desain, dan media. Data dari instrumen kuesioner dan respon siswa dianalisis dengan analisis kualitatif dan kuantitatif. Secara keseluruhan, dari hasil analisis data validasi ahli dinyatakan "sangat valid" dengan rata-rata 4,27. Hasil analisis uji empiris dengan uji perorangan, kelompok kecil, dan uji lapangan menyatakan media "sangat valid" dan siap untuk digunakan dalam pembelajaran, dengan rata-rata 4,66. Dari hasil pretest dan posttest yang melibatkan 30 orang siswa, hasil perhitungan uji t mendapatkan nilai 0,000 dengan kesimpulan terdapat perbedaan pada hasil pretest dan postest. Dari perhitungan effect size dengan cohen's d mendapatkan nilai 3,55 dengan kategori strong. Berdasarkan hasil diatas, maka aplikasi Platform Literasi yang dikembangkan dapat meningkatkan literasi membaca dan bisa diterapkan dalam pembelajaran.

A B S T R A K

Reading is the first skill to master in other literature. Students' literacy is still low, according to PISA in 2018. There is a need for efforts to improve literacy skills, one of which is the development of literacy platforms. The aim of this research is to develop multimedia learning to improve reading literacy. Research and development (R&D) is based on the Dick & Carey development model. The study was conducted at senior high school, with 30 students participating. Multimedia is validated by material, design, and media experts. Data from the questionnaire instruments and student responses are analyzed with both qualitative and quantitative analysis. Overall, from the data analysis results, expert validation data was declared "very valid" with an average of 4.27. The results of an empirical test analysis with individual, small-group, and field trials stated the media was "very valid" and ready for use in learning, with an average of 4.66. From the results of the pretest and posttest involving 30 students, the result of the calculation of the t test obtained a value of 0,000, with the conclusion that there was a difference in the outcome of the pre-test and post-test. From the calculation of effect size with Cohen's d, we get a value of 3.55 for category strong. Based on the results above, the Literacy Platform application developed can improve reading literacy and can be applied to learning.

1. INTRODUCTION

Literacy ability is a hot topic in the discussion of Indonesian society in the 21st century (Mahfudh & Imron, 2020; Warsihna, 2016). Literacy is an ability that must be mastered by someone with both reading and writing skills. Literacy has several types, one of which is reading literacy. Reading literacy is the first skill that must be mastered in order to be able to master other literacy skills. The definition of literacy in

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reading changes with the times (Nash et al., 2021; Suyono et al., 2017). Reading literacy is not just reading textbooks and receiving information from reading; it also includes understanding technology, being able to adapt to the environment, applying critical thinking, and applying what has been read (Harsiati, 2018; Tabroni et al., 2022). Literacy Reading is a way to learn more about various things, such as understanding, using, and reflecting, to gain knowledge and develop potential so that it can assist in participating in society (Supandi & Senam, 2019; Yang et al., 2018). Literacy—the ability to read well—is an essential skill to improve the quality of education. Improving reading literacy is in line with improving the quality of human resources. Literacy ability affects many things, both in society and at work. Good literacy skills will enrich information and provide insights in various fields. Low literacy skills will have an impact on the low quality of education in Indonesia. Indonesia is one of the lowest-ranking countries in terms of reading literacy (Fitrianawati et al., 2020; Supandi & Senam, 2019). The Program for International Student Assessment (PISA) published the results of a reading literacy survey. Indonesia obtained a score of 371 and was ranked 74th.

The results of the 2022 national assessment conducted by the Ministry of Education and Culture, students' reading literacy is still below 50% or below the minimum competence. Similar information was also obtained at SMA Negeri 1 Siantan, namely that many students had not reached the minimum reading literacy indicator. Some students have difficulty understanding the contents of the reading; their reading literacy ability is lower than the others. This can be caused by things such as the materials used in class, a lack of books or other reading materials at the child's home, or children not reading often from an early age. Several research efforts have been made to increase reading literacy, as done by previous study creating E-Bookstory learning media, which can be effective in increasing reading literacy (Gogahu & Prasetyo, 2020). Other research was also carried out by other study state making flipbook learning media to increase reading literacy in elementary schools (Mirnawati & Fabriya, 2022). The same thing about flipbooks was also explained which can increase reading literacy (Cholifah & Muslihasari, 2022).

The low ability of students' reading literacy can be caused by several factors, such as boring teaching materials, a lack of reading facilities, and a lack of reading habits from an early age (Chairunnisa Amelia & Pratiwi, 2020; Sari, 2017). With low student reading literacy skills, it is necessary to take serious steps to overcome this so that Indonesian students can have good literacy skills. The strategy that can be used to improve students' reading literacy is to utilize technology. One way that technology can help improve student learning is to develop multimedia that is interesting and in accordance with the desired learning objectives (Dwiqi et al., 2020; Nicolaou et al., 2019). Information technology has an important role in helping humans work, especially in the world of education (Lestari, 2018; Wahyono, 2019). The use of technology in the learning process is very useful in both direct and online learning (Aka, 2017; Sheromova et al., 2020). The learning model that is carried out depends on the readiness of the school, teachers in teaching, and students in receiving lessons. Each school has various kinds of learning, depending on the policies adopted in learning. Every school is required to always develop and improve technological knowledge in the world of education. The strategy that can be used is that teachers can help students learn by using interactive multimedia specifically designed for each student's school. Interactive learning multimedia is a combination of media to support the learning process through interaction between users and learning multimedia. The use of multimedia makes the learning process more effective (Ernawati & Sukardiyono, 2017; Novita & Harahap, 2020). The medium that is often used by the public is a mobile application. Mobile-based applications are often used by the community. The Android Operating System is used more often than other operating systems. In line with a survey conducted by the Ministry of Communication and Informatics, the results obtained showed that 70.98% of students own smartphone devices. With the large use of smartphone devices with the Android operating system, the use of Android applications can be a consideration in selecting devices for the development of learning applications.

The use of interactive multimedia can increase student involvement in learning and increase learning interest. The use of multimedia in learning is very useful, but there are still teachers who have not used it, especially at SMA Negeri 1 Siantan. From the results of interviews with two teachers at SMA Negeri 1 Siantan, the two teachers answered that they had never developed learning multimedia. Teachers still use the PowerPoint application in learning, which makes students bored in everyday learning. The use of PowerPoint is limited in learning because it is only limited to presentations and cannot add other features to learning. Interactive Learning Multimedia has often been used in learning, but it must be developed according to needs. In the development of interactive learning multimedia, interactive learning multimedia is more targeted for learning. The use of multimedia in the learning process is able to make students solve problems, think critically, and seek information, which can increase learning motivation (Munir, 2015; Sembiring et al., 2018).

Research conducted states that interactive multimedia has more value than other media because it can increase high learning motivation due to the asdvantages of multimedia, which can provide display of

text, images, video, sound, and animation with presentations that can generate reciprocal action with its users (Arif & Mukhaiyar, 2020). Based on these problems, this study aims to develop multimedia learning to improve reading literacy. The novelty of this study is to provide students material activity on reading literacy using android-based interactive. The hope is that by developing this interactive learning multimedia, it can improve students' reading literacy and make teachers more motivated to develop teaching materials.

2. METHOD

This study uses development research using the Dick & Carey development model (Dick & Carey, 2019). The Dick & Carey model consists of 10 steps, but due to time constraints and research subjects, only 9 steps are implemented. The Dick & Carey development model consists of Identity Instructional Goals, Conduct Instructional Analysis, Analyze Learners and Contexts, Write Performance Objectives, Develop Assessment Instruments, Develop Instructional Strategy, Develop and Select Instructional Materials, Design And Conduct Formative Evaluation of Instruction, and Revise Instruction. The subjects in this study were class XI students of SMA Negeri 1 Siantan. Data collection in the study was carried out using interviews, questionnaires, and test questions. Teacher data collection was conducted by interviewing Indonesian teachers to analyze the initial needs related to this research. In addition to teacher interviews, questionnaires were also given to 30 students to determine the necessary needs based on student perceptions and student desires for learning. After the multimedia is developed, application testing is carried out by distributing the instrument to material, design, and media experts. The instrument was given to six experts to determine the feasibility of the application being developed. After testing by experts and conducting trials by distributing instruments to students in 3 stages and 1 instrument for a response questionnaire after using the application. The instrument grid can be seen in Table 1.

Table 1. Instrument Grille

Instrument	Aspect	Indicator
Material Expert	Content Eligibility Aspects	Compatibility of Material with Basic Competency
		Material Accuracy
		Encourage Curiosity
	Presentation feasibility aspects	Serving Technique
		Presentation Support
	Aspects of Contextual Assessment	Contextual Nature
		Contextual Component
Design Expert	Characteristics of interactive learning multimedia	Learning objectives
		Learning multimedia has an impact on increasing interest in learning in class.
		Interactive system
	Design of learning activities	Preliminary activity plan
		Core activity plan
		Closing activity plan
	Stages of learning multimedia	earning Multimedia Systematics
		Continuity of sample questions and practice questions for students
		Continuity of each stage of learning activities
	Design Implementation Assumptions	Ease of application of the material
		Increase curiosity
		Improve reading literacy skills.
	Learning Assessment Strategy	Relationship aspect assessment
		Assessment of the scope of theoretical material
Media Expert	Utility	Ease of accessing applications
		Ease of use menus
		Application usage efficiency
		Update the contents of the application.
	Function	Login and logout work fine.
		Use of Menu Pages
		Using the Menu Button
		Use of Each Menu Page
		Use of Videos

Instrument	Aspect	Indicator
	Visual Communication	Communication
		Simplicity and attractiveness
		Visual Quality

The instruments in Table 1 are three validation instruments for material, media, and design experts to determine the feasibility of an application being developed. The instrument was distributed using a Likert scale with a score of 1–5. The criteria for the instrument can be seen in Table 2.

Table 2. Likert Scale

No	Question Scale	Score
1	Very Good	5
2	Good	4
3	Enough	3
4	Less Good	2
5	Not Good	1

There are 5 scores used in this study: very good, good, fair, not good, and not good. The data taken will be averaged and compared with the table of expert criteria in Table 3.

Table 3. Expert Validation Criteria

No	Question Scale	Score
1	Very Valid	4.1-5.0
2	Valid	3.1-4.0
3	Invalid	2.1-3.0
4	Not Valid	1.0-2.0

The last piece of data taken is a test of student learning outcomes by giving 30 questions to students before and after using the application. The data is used to see the effectiveness of using the application. The data analysis techniques used in this development research are a qualitative descriptive analysis technique and a quantitative descriptive analysis technique. Student learning outcomes are taken from pretest and posttest scores and calculated using the Shapiro-Wilk normality test, t-test (paired sample T test), and effect size test with Cohen's d.

3. RESULT AND DISCUSSION

Results

The Development of Learning Multimedia uses the Dick & Carey design model with nine stages. The first stage is to identify general goals. This stage was carried out by analyzing the results of an assessment conducted by PISA in 2018. The literacy level of students in Indonesia is very low, ranking 74th out of 78 countries. Reading literacy is the main goal that must be achieved in this study.

Another analysis that was carried out was by giving a questionnaire to 30 students who studied at SMA Negeri 1 Siantan. The results of the questionnaire can be seen in Table 4.

Tabel 4. Results of the Needs Analysis Response Questionnaire

No	Questions	Answers
1	Have gadgets	97% of students have gadgets.
2	Time to use the gadget	57% of students use gadgets for more than 5 hours.
3	Use of gadgets	33% of students use gadgets to study.
4	Internet access in schools	100% of students have smooth internet access at school.
5	Internet access at home	1100% of students have smooth internet access at home.
6	The media used by the teacher is interesting.	43% of students rated the media used as interesting.
7	Books used are complete.	63% of students rated the books used as complete.
8	Students have searched for material on the internet	100% of students have searched for other material on the internet.
9	Gadgets can be for fun learning	93% of students' perceptions are that gadgets can be fun media.

No	Questions	Answers
10	Indonesian materials delivered using gadgets	87% of students answering Indonesian material can use Android-based media.

From the results of the analysis as show in Table 4, it can be concluded that Indonesian language material can be developed using Android multimedia because it is supported by the facilities owned by students. Devices and internet access that support students' opinions related to learning can increase interest in learning. The next step is interviewing Indonesian teachers. The results obtained from the interviews showed a lack of interest in student learning in Indonesian lessons and no development of technology-based teaching materials. From this analysis, the general objective used is to develop interactive learning multimedia based on Android to improve reading literacy.

The second stage is to analyze the learning. In this stage, an analysis of the core competencies and the basic competencies used is carried out. The results of the analysis are based on Core Competency 3 Knowledge and Core Competency 4 Skills. KI 3, namely, Understanding, applying, and analyzing factual, conceptual, and procedural knowledge based on curiosity about science, technology, arts and culture, and the humanities with human, national, state, and civilization insights related to the causes of phenomena and events, and applying procedural knowledge in a specific field of study according to their talents and interests to solve problems. KI 4, including processing, reasoning, and presenting in the realm of concrete and abstract realms related to the development of what one learns at school independently and being able to use methods according to scientific rules. From the core competencies obtained, the basic competencies used are formulated, namely basic competencies 3.8 and 4.8 in class XI Indonesian language lessons. KD 3.8 is identifying the life values contained in a collection of short stories read, while KD 4.8 is determining intrinsic, extrinsic, and other values in short stories and applying the values in short stories to everyday life. The selected Basic Competencies are adjusted to the objectives achieved, namely reading literacy skills. The material on these basic competencies is in accordance with reading literacy indicators.

The third stage is identifying students. The results obtained at this stage are that students like practical learning compared to reading books, which is in accordance with the design of the development of learning multimedia, which focuses on student learning with the teacher as a facilitator. The fourth stage is formulating specific goals. The specific objectives formulated in this study were to find out the contents of the short stories, to analyze the values contained in the short stories, to be able to analyze the intrinsic and extrinsic elements of the short stories, to be able to relate the values contained in the short stories with the experiences possessed by students, and to be able to evaluate the contents of the short stories.

The fifth stage is to develop research instruments. The instruments developed included material expert validation, design expert validation, media expert validation, trial instruments, learning achievement tests, and student response questionnaires. The material validation instrument uses 15 statements with three aspects: content feasibility aspects, presentation feasibility aspects, and contextual assessment aspects. The design validation instrument was developed with 14 statements and five assessment aspects. The aspects assessed are multimedia characteristics, learning activity design, learning multimedia stages, design implementation assumptions, and learning assessment strategies. The media validation instrument uses 29 statements with three assessment aspects, namely usability, function, and visual communication aspects. The sixth stage is developing a learning strategy. This stage involves designing the RPP and formulating the needs of the developed media. The material being taught is identifying the values of life in short stories and demonstrating the values of life in short stories, with an allocation of two meetings. The media requirements used are Kodular.io, Google Drive, Google Slides, Google Sheets, and Youtube.

The seventh stage is developing and selecting teaching materials. What was done was design the initial product, validate the product by materials, design, and media experts, and conduct application trials. Initial multimedia products can be seen in Figure 1.
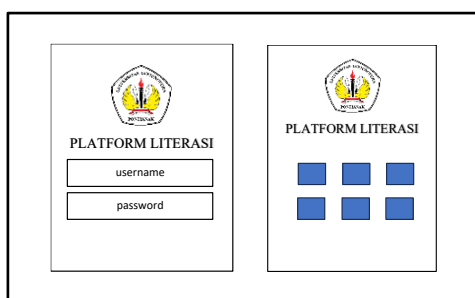

Figure 1. Initial Application Design

In Figure 1, there are two initial designs that were developed and translated into an Android-based interactive multimedia learning system. The initial application developed was validated by material, design, and media experts. This validation is used to determine the feasibility of the developed multimedia. The results of the average percentage validation of material, design, and media experts are presented in Table 5, Table 6, and Table 7.

Table 5. Material Expert Validation Results

No	Validator	Average value	Criteria
1	Expert 1	4.33	Very Valid
2	Expert 2	4.13	Very Valid

Based on Table 5, the validation results from the two material expert validators, it can be concluded that the material in the developed multimedia is very valid and feasible to use, with an average result of 4.23. The validator also provided suggestions for improvement, namely on the consultation menu, which initially used the developer's WhatsApp, to be replaced with the Indonesian language teacher's WhatsApp. Another suggestion given is to add a developer profile with developer data details. A design expert validation result is show in Table 6.

Table 6. Design Expert Validation Results

No	Validator	Average value	Criteria
1	Expert 1	4.21	Very Valid
2	Expert 2	4.14	Very Valid

Based on Table 6, the validation results from the two design expert validators, it can be concluded that the design developed is very valid and feasible to use, with an average result of 4.18. In addition to the quantitative assessment, the design expert also provided suggestions for improving the application by adding questions to train students' abilities. Media expert validation results is show in Table 7.

Table 7. Media Expert Validation Results

No	Validator	Average value	Criteria
1	Expert 1	4,41	Very Valid
2	Expert 2	4,38	Very Valid

Based on Table 7, the validation results from the two media expert validators, it can be concluded that the media developed is very valid and feasible to use, with an average result of 4.40. The validator also provides suggestions for improvement in the form of adding a logout function and adding comments to the login, namely successful login, wrong password, and empty password. From the three validations carried out, it can be concluded that the developed multimedia is suitable for use and can be continued to the trial stage.

The eighth stage is designing and developing a formative evaluation. The tryout was carried out in 3 stages: individual trials with 3 students, small group trials with 9 students, and field trials with 30 students. This trial was carried out to see if there were errors in the application and which media were effective according to the user's point of view. The trial results are presented in Table 8.

Table 8. Test Results

No	Validator	Average value	Criteria
1	Individual Trial	4.90	Very Good
2	Small Group Trial	4.89	Very Good
3	Field Trials	4.19	Very Good

Based on Table 8, the three trials that were carried out obtained very good average scores. Of the three trials, students provided several comments and suggestions for improving the application. Suggestions and comments were given, namely the existence of functional errors in practice questions, adding a welcome page before entering the menu, and modifying the quiz on the quiz page.

The ninth stage is to revise. Revisions were made at each stage of the Dick & Carey design model. Revision is not in the order of the steps of Dick & Carey but goes into each step. This revision was made to

improve every step of the development carried out in order to get better results. The most frequent revision processes are in the application development and formative evaluation steps.

Based on the results of the trials conducted, it can be concluded that the developed media is ready to be used for learning, with an average value of 4.66 across the three trials with very good criteria. The final stage is to revise. This stage can be done in the previous stage according to need. The results of the development of learning multimedia are presented in Figure 2.
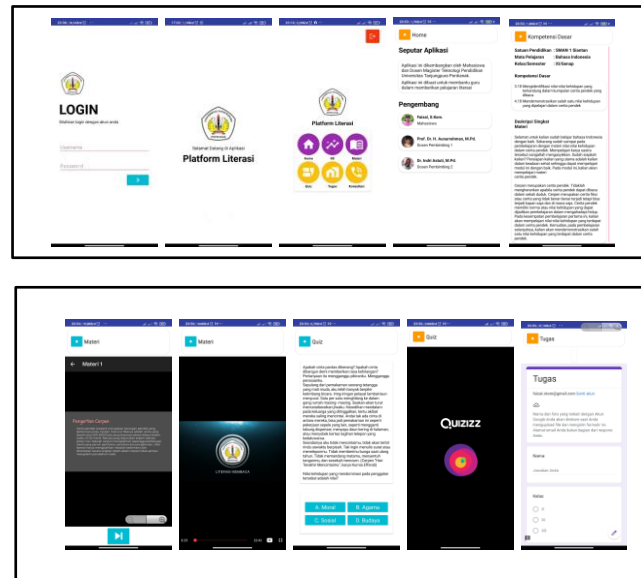

Figure 2. Learning Multimedia Profile

In Figure 2, the application is developed with six main menus: home, KD, Material, Quiz, Assignments, and Consultation. The start page uses the login function because the application developed is not for public consumption but specifically used for learning at research sites. This is because the development of this multimedia is based on the results of a needs analysis at the research site, which may not be available elsewhere. Student accounts are given by the teacher to students during learning.

The next page is the welcome page, which is used to greet users before entering the menu page. There is a 4-second delay on this welcome page before entering the menu page. The next page is the menu page, which contains the application name, logo, six menus, and the logout page. This menu is designed with round buttons along with the logo and name of each menu to make it easier for users to enter. The logout page is stored in the upper right corner, separated by the placement of the menu.

The next page is the home page, which contains the identity of the developer. This page provides information on the developer involved in making the application and has another menu to enter each developer's profile. The next page is the KD page, which contains the KD used in learning. KD is selected according to the analysis performed. The next page and the main page are the material pages. This material page contains material in the form of Google Slides and videos. This material was developed using the Google Slides feature due to its ease of use and its ability to be easily changed if there are deficiencies, errors, or additions to the material without having to change the application installed by the user.

Apart from material from Google Slides, there are also learning videos about reading literacy embedded on YouTube. Youtube is used so that the storage of this application is small and can change YouTube videos without updating the user's application. Change the YouTube link by utilizing the shortlink website from s.id, which can change the link you want on s.id without changing the link in the application.

On this material page, a quiz is also embedded after deepening the material. This quiz is designed with right and wrong logic; if the user answers correctly, they will be directed to the next material page, whereas if they answer incorrectly, they will be directed to the previous material. Users who are wrong will be asked to study the previous material if they answer incorrectly and may continue to the next material if they answer correctly. This material page is designed systematically from materials 1, 2, 3, and so on. Students cannot skip material because they have to study it step by step, from the start of the material to the end. Students are also asked to study the material until they understand it before moving on to the next material. The material is divided into two parts: the first is from Google Slides, which contains short story material, and the second is from YouTube about reading literacy skills.

The next page is the quiz page. This page is designed to overcome student boredom by inviting students to break the ice by doing quizzes simultaneously and competing to become champions. In this quiz,

it was developed using an additional website, namely Quiziz, which is embedded into the application. This quiz was developed for free and has a maximum duration of 2 weeks. This Quiziz embedding also uses the s.id feature to make it easy to change the Quiziz link if the usage duration is up and you want to renew it. The link is enough to be updated on the s.id website without having to change the user's application.

The next page is the task page, which utilizes the Google form feature. This Google form was chosen because of its excellent features to accommodate forms and document uploads. The last page is a consultation, which allows students to consult with teachers or experts in Indonesian. This consultation menu utilizes the WhatsApp link, which, if clicked, will be redirected to the WhatsApp application with the intended number. The next page is the task page, which utilizes the Google form feature. This Google form was chosen because of its excellent features to accommodate forms and document uploads. The last page is a consultation, which allows students to consult with teachers or experts in Indonesian. This consultation menu utilizes the WhatsApp link, which, if clicked, will be redirected to the WhatsApp application with the intended number.

Next, find out the effectiveness of learning multimedia by using learning outcomes questions according to reading literacy indicators. Questions were given to students before and after using multimedia learning. Then the data is calculated by the normality test using the Shapiro-Wilk test with the help of the SPSS 25 application. The results of the normality test are presented in Table 9.

Table 9. The Results of the Normality Test for Shapiro Wilk

Group	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pre Test	0.140	30	0.136	0.943	30	0.112
Post Test	0.155	30	0.065	0.941	30	0.099

Base on Table 9, the results of the normality test of Shapiro-Wilk obtained the results of the pretest and posttest above 0.05, which means that both data are normally distributed and are ready to proceed to the t test. The t-test was conducted to see differences in student learning outcomes before and after using multimedia learning. The results of the t test with the help of the SPSS 25 application are presented in Table 10.

Table 10. The Results of the T Test

| Pair | Group | Mean | Paired Differences | | | | t | df | Sig (2-Tailed) |
| | | | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference | | | | |
					Lower	Upper			
Pair 1	Pre Test-Post Test	- 22.067	4.813	0.879	-23.864	-20.110	-25.110	29	0.000

For the t-test, as show in Table 10, the error rate used is 5% (0.05), or a confidence level of 95% (0.95). After knowing the differences in learning outcomes, the next step is to find out the effectiveness of the developed multimedia. The effect size calculation uses Cohen's d model with a result of 3.55 and a strong effect interpretation. From these calculations, the developed learning multimedia is very influential on student learning outcomes.

Discussion

The development of multimedia learning to improve reading literacy has proven to be effective in learning. The media developed can overcome student boredom in learning and increase student learning motivation. The multimedia that was developed is included in innovation in learning at SMA Negeri 1 Siantan because it provides media that can improve student learning outcomesmende (Kuswanto, 2020; Tafonao, 2018; Yulianci et al., 2021). The characteristics of the developed multimedia based on Android cannot be separated from the major influence on the changes that occur because students are familiar with Android devices and this Android-based application is suitable for use in learning.

The learning that is carried out focuses on students, with the teacher acting as a facilitator who helps students understand lessons with the help of multimedia. This learning focuses on students seeking information and solving problems they find, not receiving material directly from the teacher. This learning multimedia can also assist the teacher's role in delivering material to become a learning facilitator (Arini & Umami, 2019; Miftah, 2014). The major role of multimedia learning is inseparable from input and validation

from material experts, media, and design, which determine whether multimedia is appropriate or not suitable for use.

According to the results of tests conducted on 30 students, learning multimedia can improve student learning outcomes, and students can be actively involved in learning. With the help of this technology, students can be motivated to actively participate in learning (Pandansari & Gafur, 2016; Robbia & Fuadi, 2020). In line with research conducted by previous study which said Android-based multimedia was more effectively used to improve student learning outcomes (Setiawardhani, 2021).

The use of this developed multimedia has a major influence on student learning outcomes, as evidenced by the results of the calculations, which obtained a strong effect interpretation value. Learning by combining visual and verbal elements can increase students' reading literacy (Dere, 2019; Rusmono & Alghazali, 2019). In line with research conducted by previous study which said learning with the help of visual media can improve reading literacy (Rifqiawati et al., 2020), Another study was also carried out by other study who said learning material was delivered more effectively by using mobile learning (Nasution et al., 2021). This research has greatly contributed to the development of educational technology, which can develop innovations in the field of education by utilizing the characteristics of schools and implementing student-centered learning (Rivalina & Siahaan, 2020).

This research provides several important implications for the world of education, especially in efforts to increase reading literacy at the secondary school level. First, the use of Android-based interactive multimedia can be an effective alternative in increasing students' interest and involvement in reading activities. This shows that the integration of technology in learning can provide a more interesting and enjoyable learning experience for students. Then, the results of this research can be used as a reference for educational application developers to continue to innovate in creating interactive learning materials that suit student needs. Schools and teachers can also utilize these findings to develop more effective learning strategies by utilizing technology that is already familiar to students' daily lives.

This study has several limitations that need to be noted. First, the sample of this study is limited to one secondary school in one particular location, so the results may not be generalizable to all secondary schools in various locations. Therefore, further research with larger and more diverse samples is needed to ensure these findings apply more widely. The duration of use of Android-based interactive multimedia in this study was relatively short. Long-term use may provide different or more significant results in improving reading literacy. Long-term research is needed to evaluate the lasting effects of using this technology in learning.

4. CONCLUSION

Based on the results of the research that has been done, it can be concluded that the Dick & Carey design model can be used in designing learning with nine stages. The Android-based learning multimedia that has been developed has proven to be able to improve reading literacy. This multimedia development has six menu features that have their respective functions. This learning multimedia is suitable for use in learning based on the results of validation from material, media, and design experts who show very valid results. The use of Android-based interactive learning multimedia is very effective in increasing students' reading literacy, with an effect size calculation value of 3.55 and a strong effect interpretation or being very influential on learning outcomes. This research has limitations, namely not being able to include all subjects in the application; therefore, it is hoped that further research can add features to the application and add subjects.

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