

Development of Android-Based Mobile Learning Media in Informatics Class X High School

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ABSTRACT

Most students use their smartphones to access social networks, while their use in learning activities is still limited. The aim of this research is to design mobile learning media for Android-based Informatics subjects. The development method in this research is Research and Development (R&D). This research was conducted to test the feasibility, practicality and effectiveness of a product being developed. The results of this research indicate that Android-based mobile learning for Informatics subjects is suitable for use as a media to support independent learning, in accordance with tests carried out on aspects of the material, design and media tested on students. The average feasibility score obtained from experts was 85.92% and the average feasibility score from trials was 90.56%. Practicality tests were also carried out on teachers and students, where the average score obtained from teachers was 93.33% and the average score from students was 93.06%. And the last test is the product effectiveness test where an average score of 84.9 was obtained. Based on the results obtained, it can be concluded that the validation of the results of developing Android-based mobile learning media is valid, practical and effective for use in Informatics subjects. Mobile learning Informatics can increase student interest in learning and also increase student interest in learning and also improve student learning outcomes

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1. INTRODUCTION

The development of information and communication technology has spurred digital transformation that changes the industrial order (Fukuyama, 2018). The sophistication of Internet of Things (IoT), Artificial Intelligence (AI), and robotics technology in the industrial sector has brought significant changes to society (Fukuyama, 2018). Through this technology, humans can more easily and quickly find solutions to social problems and informatics physical work (Potočan, Mulej, & Nedelko, 2020). Society 5.0 is a concept that implements technology in the Industrial Revolution 4.0 by considering the humanities aspect so that it can solve various social problems and create sustainability (Faruqi, 2019).

Talking about education in the era of Society 5.0 is of course related to changes in the learning system in that era, where this revolutionary era is very related to the prowess of the 21st Century which is related to the rapid development of technological advancement.

This is also related to the learning system which certainly refers to the concept of increasingly advanced technology.

Learning is a process of interaction between students and educators and learning resources in a learning environment in order to convey knowledge, organize, and create an environment with various methods so that students can carry out learning activities effectively and efficiently and with optimal results. The rapid development of technology in the current global era can no longer be separated from its influence on the world of education. According to Baharudi (Nurillahwaty, 2022), information technology is the development of information systems by combining computer technology and telecommunications.

The development of increasingly sophisticated technology must be balanced with the rise of education in schools. With all the advantages that today's technology has, it can provide fast and unlimited access to information, making learning materials available to students. This poses a challenge for teachers to ensure that they continue to be the most important source of learning for their students. Teachers must adapt and be able to adapt to every change that exists in order to guide their students. Rapid development requires teachers to improve learning, one of which is learning media. Innovation in learning media is currently required to be able to keep up with the development of science and technology that is developing. The development of mobile device technology that is developing rapidly is able to provide opportunities in the development of mobile learning media.

Mobile Learning has become one of the influential aspects in the field of educational technology considering the existence of mobile devices is increasingly modern and the availability of educational applications for mobile devices (Uther, 2019). Mobile learning is used as a complementary medium for learning because it provides opportunities for students to relearn poorly understood material anywhere and anytime, without physical encounters in the classroom between educators and internet students (Amirullah & Hardinata, 2017).

In the new 2022 curriculum, Informatics subjects will be taught again starting from the junior high and high school levels. This subject itself provides knowledge to students about the development of information and communication technology, computer devices, software, hardware, and other tips or tricks for using computers. Informatics is a very important subject and must be studied by students, in order to be able to use information and communication technology devices properly and optimally.

By often carrying out practicum activities in the classroom or in the computer laboratory, it will be easy for students to learn and understand the Informatics material, but there are still many teachers who only deliver the material in class and rarely do practicum activities. With this learning method, there are still many students who are not able to understand because the time for the lesson hours used is 50; 50 where 50% in the classroom and 50% in the computer laboratory. Using media in the learning process is one of the efforts to create more interesting learning. The existence of learning media can accelerate the teaching and learning process to be more effective and efficient, so that it can make students' understanding faster (Zanto, 2017).

The use of media in the process of information and communication technology development has encouraged the creation of innovation in all fields. One of the fields that does not escape this development is the field of education, which is marked by the birth of the concept of electronic learning (e-learning). E-learning is a form of learning using electronic networks (Audio, Interactive Video, Internet, CD) to convey the content of the learning. These media are considered less interesting because students are starting to get bored and spend a lot of time with a learning system that is considered monotonous and less interactive.

Online and mobile technologies can be used to learn by giving some hints and the best way. Currently, there are still several problems in the teaching and learning process, especially in the subject of Informatics, where there are several theoretical and practicum materials such as Computational Thinking so that it is quite complicated for students to learn it. Computational Thinking is a form of ability to solve problems using students' logical thinking through structured steps (Yusup, Herlambang, & Wijoyo, 2023). Computational thinking ability is the mental ability to apply ideas and concepts so that students are able to develop ideas, minimize errors, enrich information and make it easier to solve problems in everyday contexts (Ansori, Roza, & Maimunah, 2020).

The latest education reform in Indonesia introduces the Independent Curriculum (Kurikulum Merdeka), which places a strong emphasis on computational thinking. This competency has been integrated across all levels of education. Starting from elementary school, computational thinking is introduced, and by junior high school, Informatics has become a compulsory subject. This highlights the importance of fostering a computational mindset from an early age one that must be nurtured through continuous learning and practical application.

In line with this, the researcher conducted direct observations and interviews in February 2024 at SMA Pencawan Medan, particularly focusing on Class X Informatics teachers. The findings revealed that a significant number of students struggle to understand the material. The main challenges include the complexity of the content, the volume of material, and insufficient class time to cover everything comprehensively. This is reflected in student performance, where many still score below the Minimum Competency Criteria (KKM) in both Mid-Semester Exams (UTS) and Final Semester Exams (UAS).

To address these issues, the school currently utilizes learning resources such as student worksheets (LKS) and printed textbooks. However, these conventional media have limitations and are not fully aligned with the dynamic and conceptual nature of the Informatics subject. Learning media play a critical role in improving the teaching and learning process by helping to overcome classroom limitations. Well-designed media not only enhance students' understanding but also assist teachers in presenting abstract concepts in a more concrete and accessible manner.

Based on these observations, it is evident that the learning process for Informatics in Class X at SMA Pencawan Medan has not yet been optimized. The continued use of conventional approaches and teaching materials that do not support independent learning underscores the need for innovation in instructional methods. Therefore, the researcher is interested in developing a mobile learning media in the form of an Android-based application. This application will serve as an alternative learning medium that aligns with the characteristics of the Informatics subject and supports students' independent and contextual learning experiences at SMA Pencawan Medan.

2. METHOD

The type of research used in this study is research and development (R&D). Research and development is a research method used to produce a specific product and test the effectiveness of a product (Sugiyono, 2018). The model used in this study is the ADDIE (Analysis, Design, Development, Implementation, Evaluation) model. The stages of this research design are carried out through the analysis stage (analysis of curriculum and materials, analysis of media and characteristics of target users), design (design of material items to be presented, preparation of material manuscripts and preparation of material delivery flows in the form of flowcharts), development (creation of media using software, assessment by validation and revision experts)), implementation (limited trial), evaluation (media revision of target results and comments during the limited trial).

1. Analysis Stage

This stage is the stage of analyzing the curriculum, analyzing the material, analyzing the media and analyzing the level of ability and characteristics of the target user, namely students.

2. Planning Stage

This stage is the stage of designing media by continuing the material that has been analyzed from the indicators that have been outlined in the RPP syllabus so that it becomes several sub-materials that can be presented in an android-based application in *mobile learning*.

3. Manufacturing Stage

This stage begins with the process of creating an application based on the android system on a smartphone using Andromo software in which Informatics is composed with a planned media design.

4. Trial Phase

This stage is the stage where the android-based Mobile Learning media that has been revised, then completed and through the media validation stage is then tested in the trial process to grade X students.

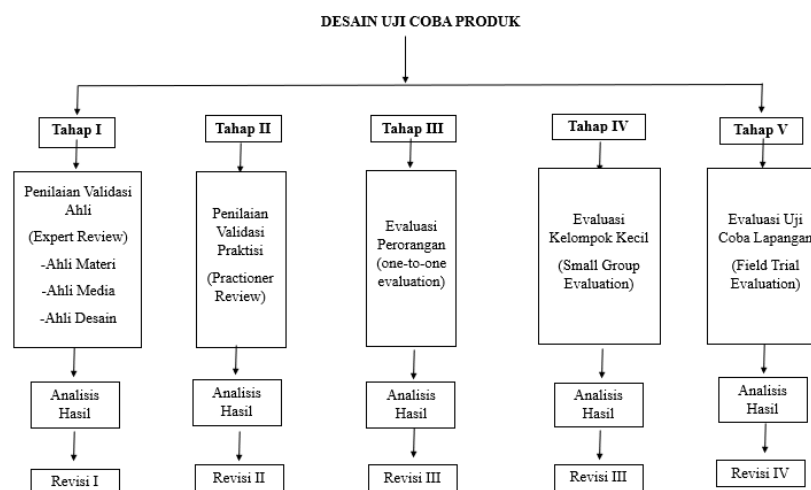
5. Evaluation Stage

This stage is a process of evaluating the results of limited trials which are then improved according to input and comments so that it becomes a product that has been in accordance with the feasibility category.

The research subject in the development of mobile informatics learning is class X students of SMA Pencawan Medan. The subjects in this study were taken by random sampling or randomly. The subjects in the control class were 30 students and the experimental class was 30 students.

The validity test assessment was carried out by material experts, design experts and media experts, the practicality test was carried out by students and teachers while the effectiveness test was carried out in the control and experimental classes. The effectiveness value of mobile learning was obtained from the comparison between the learning outcomes of students in the control class and the learning scores of students in the experimental class.

The product trial stage is as shown in figure 1.1 below:



Some of the techniques used in data collection are:

1. Interview

The interviews in this study were conducted from the beginning to the end of the research. The subjects interviewed were the Principal and Informatics Teacher at SMA Pencawan Medan. This interview was conducted face-to-face (personal interview).

2. Questionnaire

The questionnaire used during the study was in the form of an analysis of teacher and student learning, product feasibility that will be validated by material experts, media, design and acceptance of media users (users) which was carried out in stages starting from individual trial evaluation (one-to-one evaluation), small group evaluation and field trial evaluation (field trial evaluation).

3. Observation

The observation that will be carried out aims to obtain information and preliminary studies for the analysis of teachers' learning needs, including teaching materials, media that are usually used, evaluations and characteristics of students during the learning process. The researcher went directly to the field (SMA Pencawan Medan) to collect complete data and information for the needs needed by the researcher.

4. Documentation

Documentation in this study is carried out from the initial stage of the research to the end of the research as evidence of reports that the research has been carried out.

There are several instruments in this study, namely the Learning Outcome Test Instrument and the Expert Assessment Instrument for Design, Media, Materials and Student Questionnaires. The learning outcome test is used to find out whether *the mobile learning media* will be made effective or not by looking at the learning scores of informatics students after being given the treatment of the tested product (*post test*). Meanwhile, the instruments used by experts are in the form of questionnaires (questionnaires) given to material experts, design experts, media experts and class X students at SMA Pencawan Medan as respondents. A questionnaire (questionnaire) contains statements that are prepared based on theory to be responded to by the research subject.

To find the feasibility, the results obtained from the calculation are interpreted as the table below:

Table 1. 2 Presentation of Percentage Analysis Validation Assessment Criteria
(Sugiyono, 2018)

It	Alternative Answer	Score
1.	85%-100%	Highly Worthy
2.	70%-84%	Proper
3.	55%-69%	Quite Decent
4.	40%-54%	Less Worthy
5.	0%-39%	Not Eligible

Table 1. 3 Interpretation of Product Quality Assessment (Sriadhi, 2018)

It	Mean Score Interval	Interpretation
1	4.17-5,00	Highly Worthy
2	3.33-4,16	Proper

3	2.50-3.32	Less Worthy
4	1.00-2.49	Not Eligible

The effectiveness of mobile learning was obtained from the difference in the learning outcomes of students in the control class and the experimental class. The difference in question is the difference between the learning outcomes of the experimental class and the control class, if the improvement in the learning outcomes of the experimental class students is higher than that of the control class, then mobile learning can be said to be effective. For significant testing, it can be done with a t-test. Before nailing the t-test, a normality and homogeneity test is first carried out.

Normality Test

The normality test is used to determine whether the distribution of learning outcome data is normal or not.

Homogeneity Test

The criterion for this test is as follows: if $F_{cal} < F_{table}$ at a significance level of 5%, then the research data is considered homogeneous.

Uji Independent T Test

The hypothesis for the effectiveness test is as follows:

- H₀ : There is no significant difference in learning outcomes between the class taught using Android-based mobile learning media and the class taught using other learning media, namely PowerPoint.
- H_a : There is a significant difference in learning outcomes between the class taught using Android-based mobile learning media and the class taught using other learning media, namely PowerPoint.

3. Results and Discussion

Result

Development of Mobile Learning Learning Media



Figure 1. Application Splash Screen View

This view is the splash screen that appears immediately after the application is opened. This screen usually displays the logo, application name, and developer identity briefly. The goal is to provide a professional first impression and introduce the application before the user enters the main page.

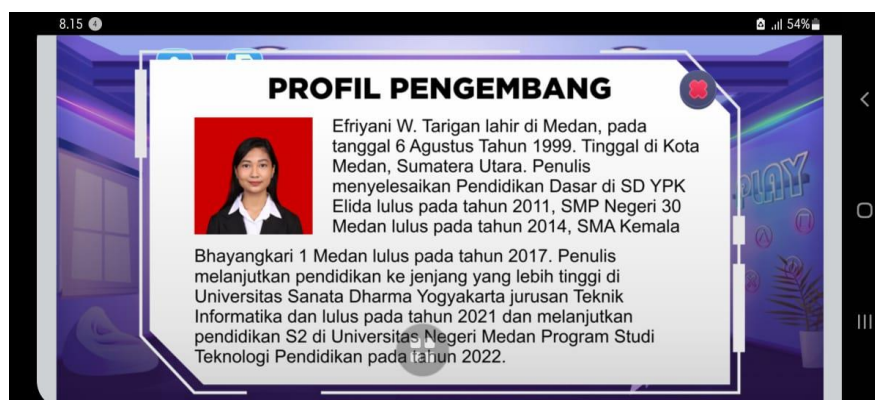


Figure 2. "Developer Profile Menu Display

This menu contains brief information about the application developer. It contains biodata, institution of origin, and a brief background of the developer. This feature adds an aspect of credibility to the product created and provides appreciation for the developer.

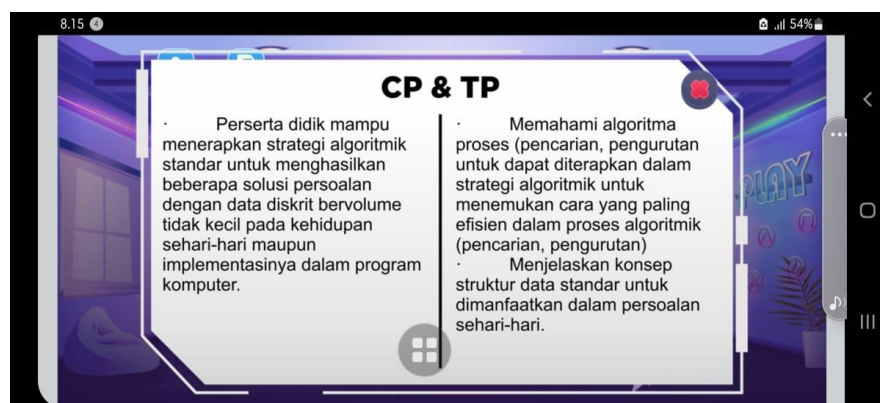


Figure 3. "CP&TP" (Computational Problem & Thinking Practice) Menu Display

This menu provides access to materials and exercises related to computational thinking, in accordance with competencies in Informatics subjects. CP&TP is one of the core learning that supports students in thinking logically and systematically through a problem-based approach.

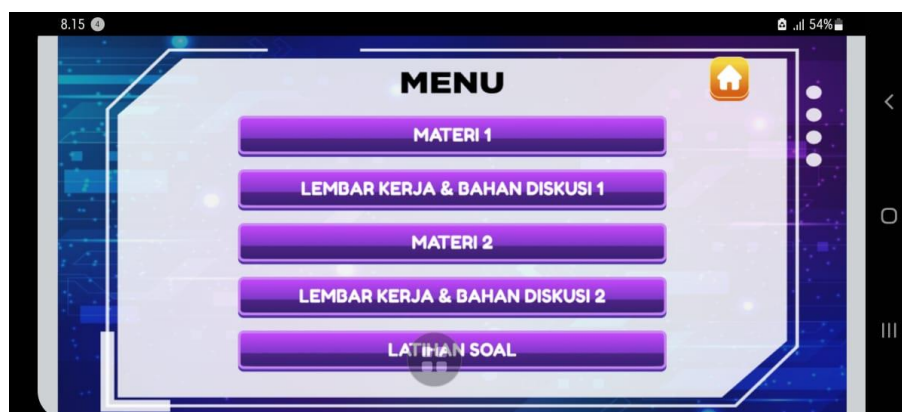


Figure 4. Main Menu Display After Clicking "Start"

After pressing the “Start” button, the user is directed to the main display of the application which presents several menu options, such as learning, practice questions, discussions, and evaluations. This display is interactive and makes it easy for students to explore all the application features independently.

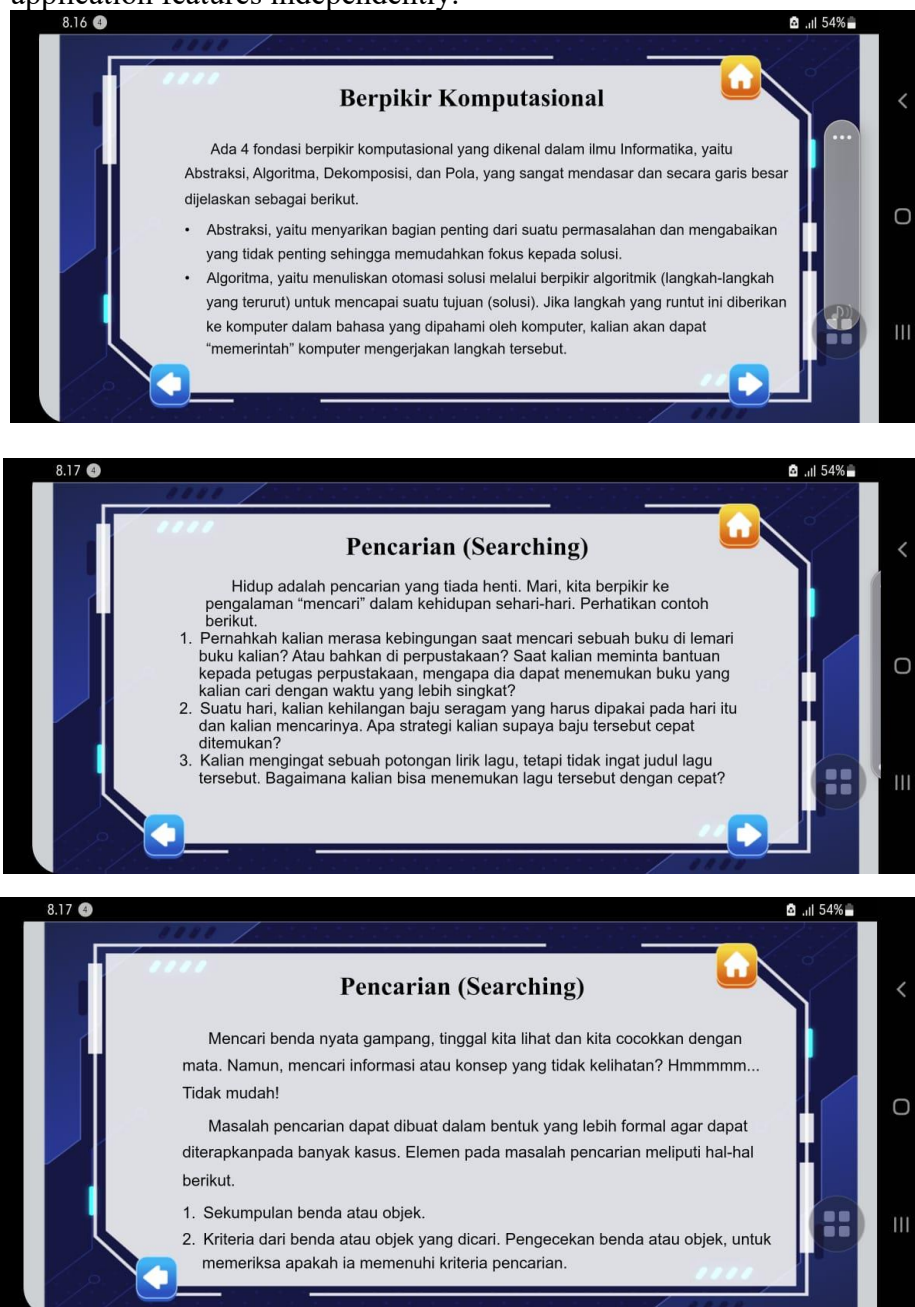


Figure 5. “Lesson 1” Menu Display

This menu contains the first learning material in the topic of Informatics. The contents of the material are presented in an attractive text and visual format, and are arranged systematically starting from definitions, explanations of concepts, to examples of applications to facilitate student understanding.

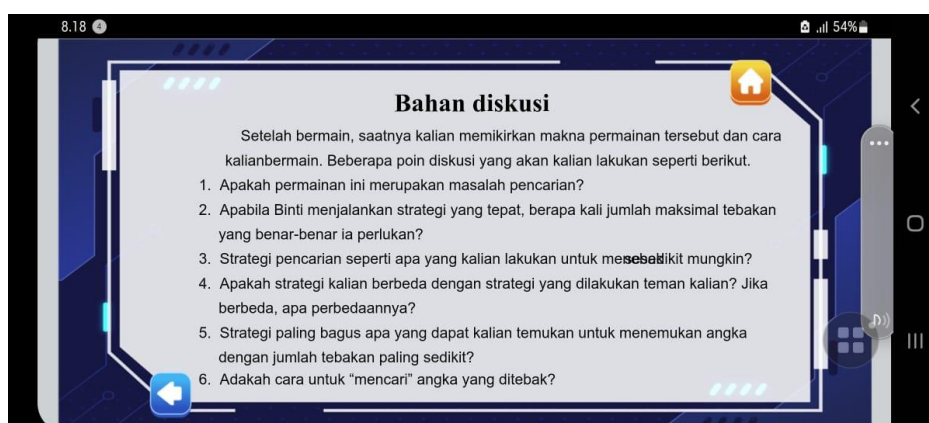
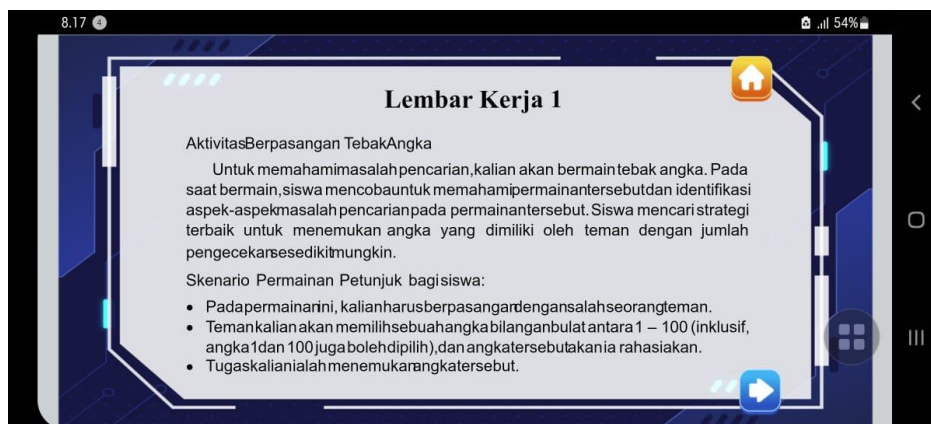
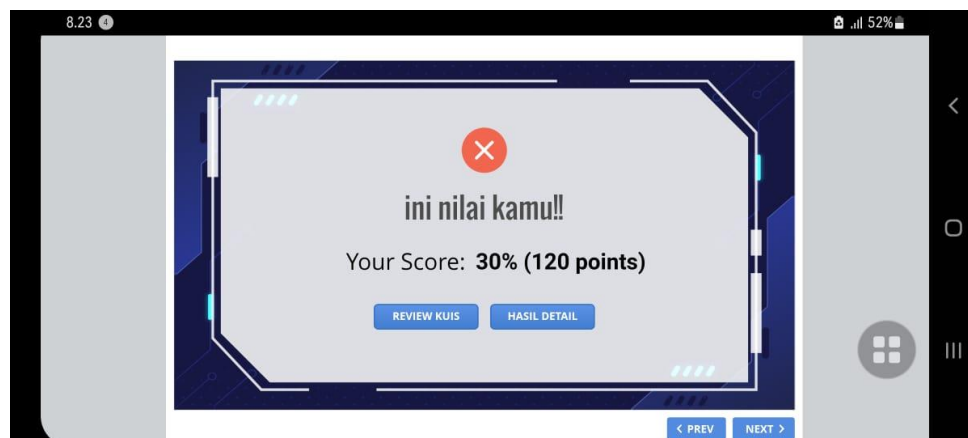
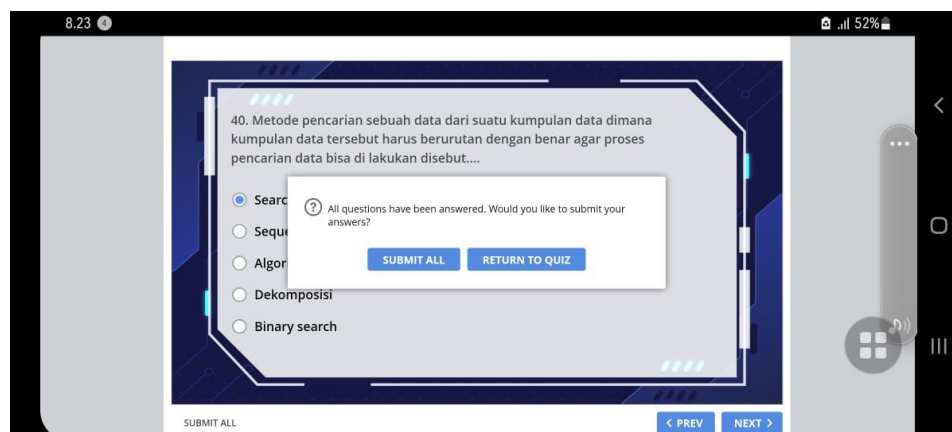
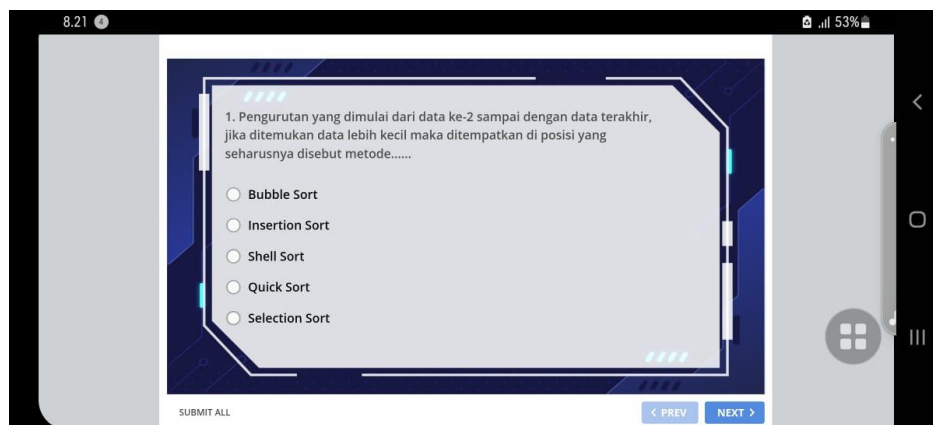


Figure 6. Worksheet Display and Discussion Material 1

This view shows part of the student worksheet (LKS) and discussion materials that support collaborative learning. Through this feature, students can work on questions while discussing in small groups, both online and offline, thus encouraging active interaction in learning.



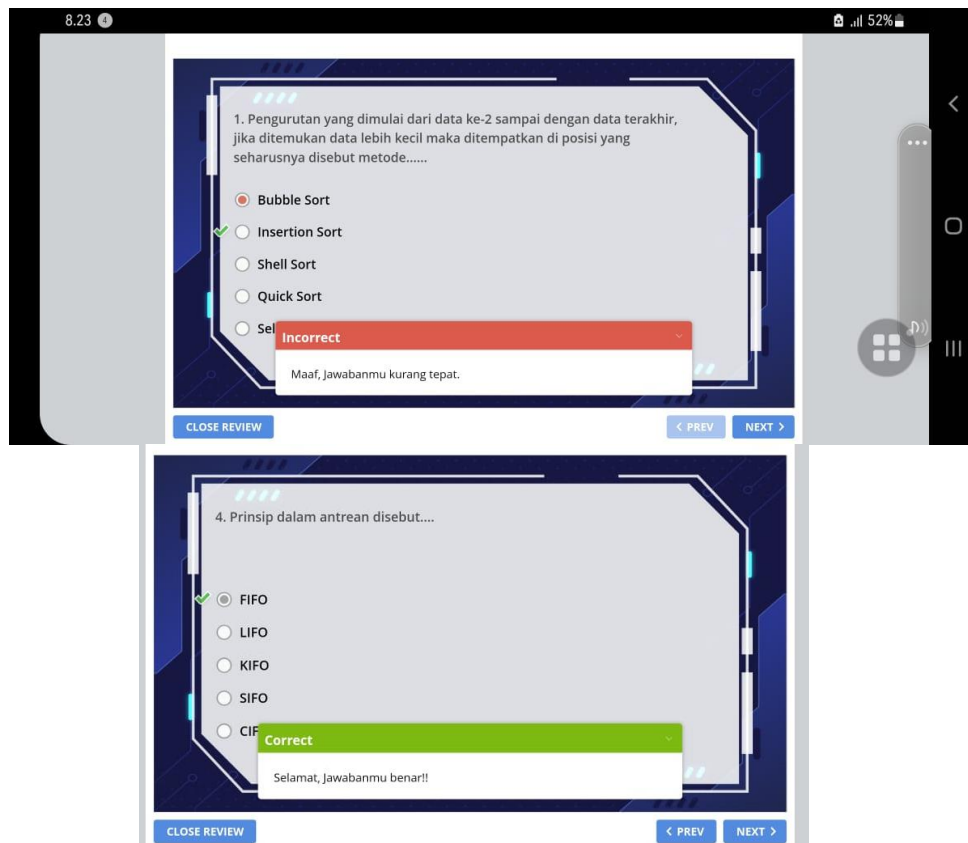


Figure 7. "Lesson 2" Menu Display

Like Lesson 1, Lesson 2 presents advanced learning materials. The materials are arranged based on the curriculum structure and developed to suit the characteristics of high school students in grade X. Interesting visualizations are also an added value in presenting this material.

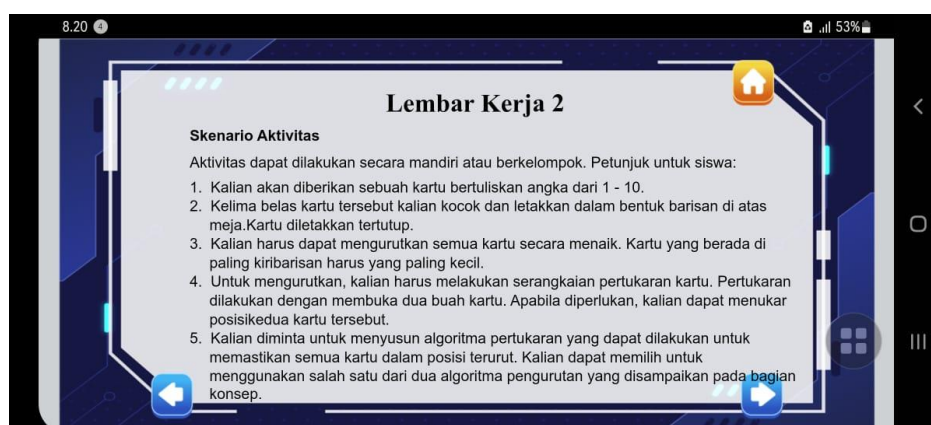


Figure 8. Worksheet 2 view

This second worksheet provides practice questions and activities that are directly related to the material in Lesson 2. This worksheet aims to hone conceptual understanding and test students' ability to apply knowledge through various forms of questions, including case studies.

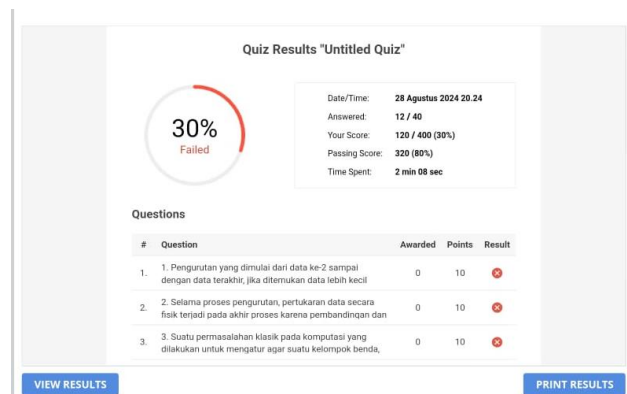


Figure 9. Evaluation

This section provides practice questions or final evaluations to measure students' competency achievement after studying all the materials. The questions are arranged with varying levels of difficulty and are equipped with automatic assessment features to make it easier for teachers to monitor student learning outcomes.

Validity Test Research Results

Based on the results of the validity test with experts where there are 2 material experts, 2 design experts, and 2 media experts, the average score for material experts is 4.65. As in the table below:

Table 2. 1 Score of Assessment Results by Material Experts

It	Assessment Aspects	Member 1	Member 2	Average	Percentage	Criterion
1	Learning Guides and Information	4.5	5	4.75	95	Highly Worthy
2	Material Quality	4.33	4.75	4.54	90.83	Highly Worthy
3	Evaluation	4.625	4.75	4.68	93.75	Highly Worthy
Average		4.48	4.83		93.19	Highly Worthy

The average score for media experts is 4.16 as in the table below:

Table 2. 2 Score of Assessment Results by Media Experts

No	Assessment Aspects	Member 1	Member 2	Average	Percentage	Criterion
1	Systematics	4.33	3.67	4	80	Proper
2	Aesthetic	4.75	4	4.37	87.5	Highly Worthy
3	Media Quality	4.58	3.67	4.13	82.5	Proper
Average		4.55	3.78	4.16	83.33	Proper

The average score for design experts is 4.06 as in the table below:

Table 2. 3 Score of Assessment Results by Design Experts

No	Assessment Aspects	Member 1	Member 2	Average	Percentage	Criterion
1	Learning Objectives	4	4	4	80	Proper
2	Learning Activities	3.33	4.67	4	80	Proper
3	Learning Methods	3.83	4.17	4	80	Proper
4	Learning Media	4	4.75	4.38	87.5	Highly Worthy
5	Time	3.33	4.67	4	80	Proper
6	Your	4	4	4	80	Proper
Average		3.75	4.38	4.06	81.25	Proper

Practicality Test Research Results

Practicality is related to the ease of use of mobile learning developed. Practicality data was obtained through a questionnaire filled out by a teacher. The results of the practicality test are based on the teacher's response as in the table below.

Table 2. 4 Score of Practicality Assessment Results by Teachers

No	Assessment Aspects	Mean	Percentage	Criterion
1	Material suitability	5	100%	Very Practical
2	Presentation of material	4.67	93.33%	Very Practical
3	Product presentation	4.33	86.67%	Very Practical
4	Product Usage	4.67	93.33%	Very Practical
Average		4.67	93.33%	Very Practical

The practicality of mobile learning also requires input in the form of responses from students. This data was obtained after learning, through a questionnaire given to students. The following are the results of the practicality test based on student responses in the table below.

Table 2. 5 Scores of Practicality Assessment Results by Students

It	Assessment Aspects	Mean	Percentage	Criterion
1	Material Suitability	4.63	92.67 %	Very Practical
2	Presentation of Materials	4.70	94 %	Very Practical
3	Product Presentation	4.60	92 %	Very Practical
4	Product Usage	4.68	93.56 %	Very Practical
Average		4.65	93.06	Very Practical

Based on the results of the practical analysis test of the response of teachers and students to the practicality of mobile learning, it can be concluded that the mobile learning developed in several categories is very practical, which means that it makes it easier for students to understand informatics learning, especially computational thinking material.

Results of Effectiveness Test Research

The results of the effectiveness test were obtained through the calculation of the learning outcomes of students in the control class and experiments. The results of the research in the experimental class obtained the lowest score of students was 67 and the highest score was 97 while the mean value was 84.9 with a mode of 87 and a standard deviation of 43.9 The following is the descriptive data of the class learned with informatics learning media, or called the experimental class.

Table 2. 6 Frequency Distribution of Post Test Results of Experimental Classes

No	Class Interval	Classroom Edge	Frequency	Relative Frequency
1	67-72	66.5-72.5	1	3,3 %
2	73-78	72.5-78.5	2	6,7 %
3	79-84	78.5-84.5	13	43,3 %
4	85-90	84.5-90.5	9	30 %
5	91-96	90.5-96.5	3	10 %
6	97-102	96.5-102.5	2	6,7 %
Sum			30	100 %

While the results of the research in the control class obtained the lowest score of students was 57 and the highest score was 90 while the mean value was 74.9 with a mode of 77 and a standard deviation of 56.3, the following is descriptive data of the class that was learned without informatics learning media based on an android application, but learned with power point or called the control class.

Table 2. 7 Frequency Distribution of Control Group Post Test Results

		Classroom Edge	Frequency	Relative Frequency
1	57-62	No	Class Interval	6,7 %
2	63-68	62.5-68.5	3	10 %
3	69-74	68.5-74.5	8	26,7 %
4	75-80	74.5-80.5	13	43,3 %
5	81-86	80.5-86.5	1	3,3 %
6	87-92	86.5-92.5	3	10 %
Sum			30	100 %

Normality Test

From the results of the normality test that has been carried out using Microsoft Excel, the results are obtained as in the following table

Table 2. 8 Results of the Normality Test of the Experimental Class with the Chi-Square Method (χ^2)

No	Class	Chi-Square (χ^2) Calculate	Chi-Square (χ^2) Table	Conclusion
1	Eksperimen	4.01	11.0705	Normal
2	Control	3.6	11.0705	Normal

From the table above, it can be seen that the normality test value in the experimental class data χ^2 calculated $< \chi^2$ table ($4.01 < 11.0705$), while for the control class the value χ^2 calculated $< \chi^2$ table ($3.6 < 11.0705$). So it can be concluded that the data is distributed normally.

Homogeneity Test

In the homogeneity test, if $F_{cal} < F_{table}$, then the distribution of data is said to be homogeneous. However, if it is the opposite, then the distribution of data is said to be not homogeneous. From the post-test data of the experimental class and the control class, the value of variance max = 7.3 and variance = 6.5697 was obtained, then $F_{cal} = \frac{Variansmax}{Variansmin} = \frac{7,3}{6,5697} = 1.1082$ with $F_{table} = 1.8608$. Thus, it can be concluded that the value of $F_{cal} < F_{table}$ ($1.1082 < 1.8608$), which means that the distribution of data is said to be homogeneous.

Test T

For a significance level of 5% ($\alpha=0.05$), the value of the table with the degree of freedom is 58. Based on the t-distribution table, the ttable values for $db=58$ and $\alpha=0.05$ (two-sided test) are 2.00. So, it can be concluded that the $t_{count} > t_{table}$ ($5.41 > 2.00$). This means that the null hypothesis is rejected and the alternative hypothesis is accepted. This means that the mean difference between the two groups is significant at a significance level of 5%.

Discussion

The development of mobile learning-based learning media in Informatics subjects is carried out through a series of systematic processes to produce valid, practical, effective, and efficient products. The development model used is ADDIE, which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation. This model has proven effective in designing and developing learning programs, including in the context of online learning and mobile learning (Ramadani et al., 2024).

In the Analysis stage, learning needs and characteristics of students are identified. The Design stage involves designing the structure and content of learning that is in accordance with learning objectives. Furthermore, the Development stage includes the creation of a prototype of Android-based mobile learning media. The Implementation stage is the implementation of a trial of learning media in class X of SMA Pencawan Medan. Finally, the Evaluation stage is carried out to assess the effectiveness and efficiency of the learning media that has been developed (Ranuharja et al., 2021).

Validation of learning media is carried out by experts to ensure the quality and suitability of the media to learning standards. There are two material validators, two design validators, and two media validators involved in this process. The validation results show that the average score from the material validator is 4.65, from the media validator is 4.16, and from the design validator is 4.06. These values indicate that the developed learning media has a high level of validity and is suitable for use in the learning process (Spatioti, Kazanidis, & Pange, 2022). The assessment of the practicality of the learning media was obtained through a questionnaire filled out by teachers and students. The results showed that teachers gave an average score of 4.67 or 93.33%, while students gave an average score of 4.65 or 93.06%. This shows that the Android-based mobile learning media developed is very practical and easy to use by users.

The effectiveness of learning media was tested through a learning outcome test conducted at the end of learning. The data showed a significant difference in learning outcomes between the control class and the experimental class. Classes using Android-based mobile learning media showed a higher increase in learning outcomes compared to classes using conventional learning media. This is in line with previous research findings showing

that the use of the ADDIE model in developing learning media can increase learning effectiveness.

Overall, the development of Android-based mobile learning media using the ADDIE model in Informatics subjects at SMA Pencawan Medan has proven to be valid, practical, and effective. This model can be used as a reference in developing similar learning media in other subjects and levels of education.

4. Conclusion

Based on the formulation, objectives, results, and discussion of the development of Informatics learning media in the form of an Android-based application, the following conclusions can be drawn:

- a. The Android-based mobile learning media developed for Informatics is appropriate for use in delivering computational thinking material in Class X at SMA Pencawan Medan.
- b. The Android-based mobile learning media developed for Informatics is practically applicable for teaching computational thinking material in Class X_o at SMA Pencawan Medan.
- c. The Android-based mobile learning media developed for Informatics is effective in improving student learning outcomes in computational thinking material in Class X at SMA Pencawan Medan.

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