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Development of Android-Based Interactive Learning Media on Computer Assembly Material with the ADDIE Model Approach

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ABSTRACT

This study raises the title of the development of android-based interactive learning media on computer assembly material at SMK Negeri 1 Lolayan. Based on the observations and interviews, several problems were found in learning computer assembly material, including teachers still using PowerPoint learning media that is only text-based. During the practicum, one of the computers used was damaged. This is due to limited knowledge and inadequate facilities, resulting in teachers' lack of innovation and creativity in developing learning media, which makes it difficult for students to understand the material. This study aims to develop android-based interactive learning media on Computer Assembly material for class X TKJ students at SMK Negeri 1 Lolayan and test the feasibility of interactive learning media through material and media expert feasibility tests and determine the practicality of learning media through respondent trials (students/users). The research method used is Research and Development (R&D) with the ADDIE development model (Analyze, Design, Development, Implementation, Evaluation). The results of this study were obtained from feasibility testing by material experts, who obtained an average value of '138' with the criteria 'Very Feasible.' The results of feasibility testing by media experts obtained an average value of '120' with the criteria 'very Feasible,' and the results of testing student response responses obtained an average value of '101' with the criteria 'Very Feasible'. The results showed that Android-based interactive learning media is feasible to use as an alternative to learning computer assembly.

1. INTRODUCTION

Education plays an important role in the nation's life and serves as a tool to preserve and develop aspects of knowledge [1], [2]. In formal education, schools play a key role in facilitating the knowledge exchange process between students and teachers. Learning effectiveness often relies on learning media that can utilize students' senses of hearing and sight to accelerate their understanding. However, conventional learning media is often insufficient to achieve optimal results, so teachers must be more innovative in choosing and developing learning media [2,3]. Learning media is a media that can support the teaching and learning process of students to be more interesting, with the learning media the material that is distributed becomes clearer so that the learning process can run well [4-6]. Effective teaching is becoming increasingly important at the vocational secondary education level, which emphasizes the development of practical. SMK Negeri 1 Lolayan, especially the Computer and Network Engineering (TKJ) department,

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focuses on Basic Computer and Network subjects, including Computer Assembly material. Computer assembly is one of the materials used in basic computer and networking, and it is the focus of this research. This material aims to provide students with an understanding of the process of building a computer by combining several hardware devices into a working system. Initial observations and interviews with teachers at this school revealed that theory learning still relies on conventional media such as PowerPoint, which is text-based. As a result, students experience difficulties during practice, resulting in unsatisfactory learning outcomes. For the past two years, the average student score in this subject has not met the Minimum Completion Criteria (KKM) of 75, with a pass percentage below 40%.

The lack of learning media innovation can hinder the achievement of learning objectives [7] and reduce student motivation and enthusiasm for learning [8]. Therefore, effective strategies are needed in the learning process, including utilizing interactive media as a learning medium that has been proven to motivate students so that it can improve student achievement [9-11] Computer technology and Android smartphones have also been proven feasible in supporting learning; as stated by [12-14], we can use them to achieve learning goals. Based on the background written previously, it is the main basis for conducting research titled: Development of Android-Based Interactive Learning Media on Computer Assembly Material at SMK Negeri 1 Lolayan. Thus, researchers provide solutions to overcome the problems at SMK Negeri 1 Lolayan, especially in Computer Assembly material in class X, namely by developing Android-based learning media to make it easier for students to understand Computer Assembly material. The ability to access this media from any location and by anyone positions Android-based learning media as an innovative and promising field for [15-17], using the ADDIE development model in designing instructional systems using a systems approach. The essence of this systems approach is to divide the learning planning process into several structured steps, organize those steps into a logical sequence, and then use the output of each step as input to the next step [18]. With Android-based interactive learning media, students are expected to be more active and independent in the learning process and have the flexibility to learn anytime and anywhere, inside and outside the school environment.

2. METHOD

According [9], the ADDIE model is a framework for designing learning systems. Its organization facilitates the creation of effective and efficient training programs. Development research is defined as a systematic study to design, develop, and evaluate programs [10 ,18] . This research uses the Research and Development (R&D) method using the ADDIE development model that [12] developed in his book Instructional Design The ADDIE Approach. The ADDIE development model consists of 5 main steps, namely: (1) Analysis, (2) Design, (3) Development, (4) Implementation, and (5) Evaluation.

2.1 Collection Data Instrument

The following are the research instruments that researchers will use in collecting data:

A. Questionnaire Sheet

The questionnaire sheet contains media expert feasibility test instruments, material expert feasibility test instruments, and student response instruments.

a. Media Expert Feasibility Test Instrument

Table 1. Media Expert Feasibility Test Instrument

No.	Aspects	Number of Items
1.	View	4
2.	Ease of Operation	4
3.	Consistency	3
4.	Format	2
5.	Sound	2
6.	Navigation	2
7.	Usability	5
8.	Animation	3
	Total	25

The table above is a media expert feasibility test instrument to assess the developed learning media. There are 8 aspects assessed with different number of questions in each aspect:

1. View (4 questions): Assessing the visual appearance of the media, such as layout design and graphic quality.
2. Ease of Operation (4 questions): Assesses the ease of use of the application by users, especially in accessing media features.

3. Consistency (3 questions): Assesses the consistency of appearance and navigation throughout the media, including using colors, fonts, and design elements.
4. Format (2 questions): Assesses the format of the information presentation and whether it conforms to easy-to-understand standards.
5. Sound (2 questions): Assess the quality of audio used in the media, including clarity and relevance.
6. Navigation (2 questions): This question assesses the ease of navigation, i.e., how easily users can move from one part of the media to another.
7. Usability (5 questions): Assessing the app's usability in supporting learning effectively.
8. Animation (3 questions): Assessing the quality of animation, such as fluidity and relevance of animation in supporting learning materials.

A total of 25 questions were used to test the feasibility of the media in terms of appearance, ease of use, and functionality.

b. Material Expert Feasibility Test Instrument

Table 2. Material Expert Feasibility Test Instrument

No.	Aspects	Number Of Items
1.	Content Appropriateness	8
2.	Language	7
3.	Presentation	7
4.	Graphics	6
	Total	28

The table above is a material expert feasibility test instrument used to assess the quality of learning media content. There are 4 aspects assessed, each with several questions:

1. Content Appropriateness (8 questions): Assessing the suitability and completeness of the material presented with the curriculum and learning needs.
2. Language (7 questions): Assessing the clarity and appropriateness of the language used, both in terms of grammar and the level of student understanding.
3. Presentation (7 questions): Assess the way the material is presented, including structure, flow, and effectiveness of delivery.
4. Graphics (6 questions): Assess the quality of the graphics used, such as the clarity of images, diagrams, and other visual elements that support the understanding of the material.

There are 28 questions to assess the quality of content, language, presentation, and graphics in the learning media.

c. Student Response Assessment Instrument

Table 3. Student Response Assessment Instrument

No.	Aspects	Number Of Items
1.	Presentation of Material	7
2.	Language	4
3.	Graphics	7
4.	Benefits	6
	Total	24

The table above is an instrument for assessing student responses to interactive learning media. Each aspect has several questions to measure the effectiveness of the media:

1. Presentation of Material (7 questions): Assess the quality of the presentation of the material, including the flow, structure, and way of delivering the information.
2. Language (4 questions): This assessment assesses the clarity of the language used, whether students easily understand it, and whether it is appropriate for the learning level.
3. Graphics (7 questions): Assess the quality of the graphics, such as illustrations, diagrams, and pictures, that help deliver the material.
4. Benefits (6 questions): Assessing how much this media benefits students in understanding the material and achieving learning objectives.

There are 24 questions to evaluate the quality of presentation, language, graphics, and benefits of the learning media.

2.2 Data Analysis Technique

The data analysis technique used in this research is qualitative descriptive analysis, which describes the results of product development in the form of interactive learning multimedia. [13] revealed that the data obtained through questionnaires from media experts, material experts, and students will be converted into quantitative values expressed in the Likert scale score distribution. After the data is collected, the average gain with the data will be calculated using the arithmetic mean formula:

$$\underline{X} = \frac{\sum \quad X}{N} \tag{1}$$

explained :
$\underline{X}$ = Average Score
$\sum \quad X$ = Total Score
N = Number of Assessors
The provisions of the ideal assessment criteria are shown in the following table:

Table 4. Ideal Assessment Criteria

No.	Qualitative Score Range	Qualitative Criteria
1.	$\underline{X} > M_i + \mathbf{1{,}8}\ SB_i$	A
2.	$M_i + \mathbf{0{,}6}\ SB_i < \underline{X} \leq M_i + \mathbf{1{,}8}\ SB_i$	B
3.	$M_i - \mathbf{0{,}6}\ SB_i < \underline{X} \leq M_i + \mathbf{0{,}6}\ SB_i$	C
4.	$M_i - \mathbf{1{,}8}\ SB_i < \underline{X} \leq M_i + \mathbf{0{,}6}\ SB_i$	D
5.	$\underline{X} \leq M_i - \mathbf{1{,}8}\ SB_i$	E

Skor minimum ideal = $\sum criteria\ items\ x\ lowest\ score$ (2)

Table 5. Criteria for Material Expert Feasibility

No.	Qualitative Score Range	Qualitative Criteria
1.	$\underline{X} > 117{,}61$	Very Decent
2.	$95{,}2 < \underline{X} \leq 117{,}61$	Feasible
3.	$72{,}8 < \underline{X} \leq 95{,}2$	Decent Enough
4.	$50{,}93 < \underline{X} \leq 72{,}8$	Not Feasible
5.	$\underline{X} \leq 50{,}93$	Very unfeasible

The table above presents the qualitative assessment criteria used to evaluate the learning media quality based on the material expert's average score ($\overline{X}$). Each criterion describes the feasibility level of the learning media as follows:

1. Very Decent ($\overline{X} > 117.61$): If the average score exceeds 117.61, this criterion indicates that the learning media is considered very good and feasible.
2. Feasible ($95.2 < \overline{X} \leq 117.61$): If the average score is between 95.2 and 117.61, this criterion indicates that the learning media is feasible and can be applied well in learning.
3. Decent Enough ($72.8 < \overline{X} \leq 95.2$): If the average score is within the range between 72.8 to 95.2, this criterion indicates that the learning media is good enough but still requires some improvements to achieve optimal results.
4. Not Feasible ($50.93 < \overline{X} \leq 72.8$): If the average score falls between 50.93 to 72.8, this criterion indicates that the learning media is considered less feasible and needs significant revision before it can be used effectively.
5. Very Unfeasible ($\overline{X} \leq 50.93$): If the average score is less than or equal to 50.93, this criterion indicates that the learning media is considered unfeasible and cannot be applied in learning.

3. RESULTS AND DISCUSSION (10 PT)

3.1. Results

At this stage, researchers conducted a needs analysis through field observations and interviews about learning computer assembly material. This activity aims to collect data on the learning conditions in class X SMK Negeri 1 Lolayan, namely:

1. The use of learning media is still classified as conventional; in this case, the PowerPoint media used is only text-based.

2. The use of PowerPoint media that is only text-based impacts students' lack of understanding of how to assemble computers. When students carry out practicum assembling computers, the problem faced by students is that one of the computers being used is damaged.
2. Inadequate facilities are also a factor in teachers' lack of innovation and creativity in developing learning media.
3. Data from the last two years show that the percentage of students' average scores in Basic Computer and Network subjects in Class X TKJ at SMK Negeri 1 Lolayan who have not met the Minimum Criteria (KKM) with a KKM score of 75 is still below 40%.

At this stage of design, the researcher creates the initial product design, which is a flowchart and storyboard design. The flowchart design is shown in Figure 1

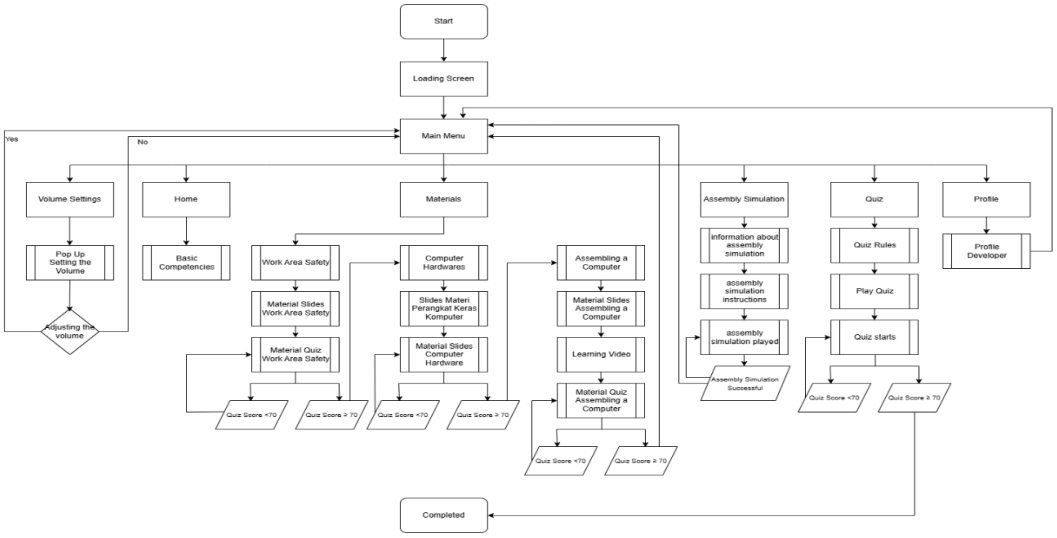

Figure 1. Flowchart Design

3.1.1 Development

a. Display of interactive learning media based on android

The following are the results of product development in the form of Android-based interactive learning media on computer assembly material:

Figure 2. Main Menu

On this page, users (students) can access several menus. These include the home menu, material menu, game menu, quiz menu, and developer profile menu. There is also a volume setting button.

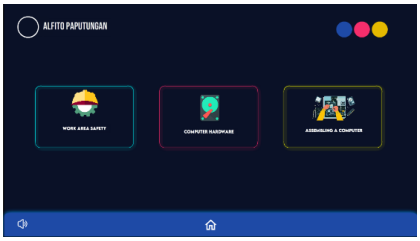

Figure 3. Material Page

On the material menu page, users (students) can access three main materials: work area safety material, computer hardware material, and computer assembly material. There is also a home button and a volume setting button.

Figure 4. Quiz Menu

On the quiz page, there is a question text and four answer choice buttons that can be selected by the user (student), which option the user (student) thinks is correct. This quiz page has a volume setting button and a timer for 20 (twenty) seconds.

b. *Testing*

The testing stage aims to test the application (interactive learning media) to ensure that all functions have run correctly and to find errors that need to be corrected.

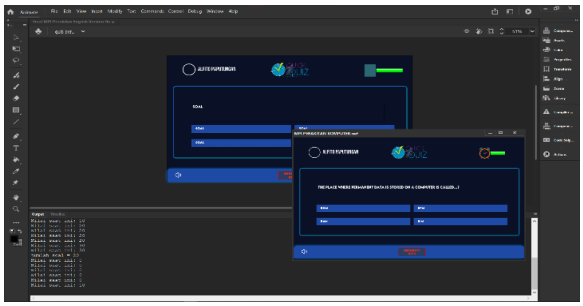

Figure 5. Testing Process

c. Product Packaging

Product packaging is the process of uploading the raw file of the Android-based interactive learning media in the form of (.APK) format to Google Drive so that it can be downloaded and installed by students on their respective Android smartphones.

d. Product Validation

At the product validation stage, this interactive learning media was validated by two media experts and one material expert with the assessment.

a) Material Expert Validation Test Results

Table 6. Material expert validation test results

No.	Aspect	Material Expert					Total Score
		1	2	3	4	5	
1.	Content appropriateness					40	40
2.	Language					35	35
3.	Presentation				8	25	33
4.	Graphics					30	30
	Total Score						138
	Average						138
	Criteria						Very Feasible

The table above shows the assessment results from a material expert regarding the feasibility of learning media content. Four aspects are assessed, and each aspect's score is shown separately. Here are the details of each aspect:

1. Aspect: Categories assessed, including:
   - Content appropriateness: An assessment of the appropriateness of the material to the curriculum and learning needs, scoring 40.
   - Language: Assessment of the clarity and appropriateness of the language used, scoring 35.
   - Presentation: Assessment of the way the material is presented, including flow and structure, with a score of 8 and 25, resulting in a total of 33.
   - Graphics: An assessment of the graphics' quality that supports the material's delivery, scoring 30.
2. Material Expert (1, 2, 3, 4, 5): This column shows the score given by the material expert for each aspect. In this table, one expert gave different ratings for different aspects.
3. Total Score: Shows the total number of scores from all aspects assessed. The total score is 138.
4. Average: The average score obtained from the judgments, which in this case is also 138, shows that the judgments from the material experts are very consistent.
5. Criteria: The eligibility criteria are based on the total score. In this table, the criteria show that the learning media is rated Very Feasible, which means that it is very feasible to use in learning.

Overall, this table illustrates one subject matter expert's positive assessment of the learning media, emphasizing that the content presented is appropriate and of high quality. After the data is obtained from the material expert, the average value obtained matches the material expert's eligibility criteria table. The eligibility criteria can be seen in the following table:

Table 7. Criteria for Material Expert Feasibility

No.	Qualitative Score Range	Qualitative Criteria
1.	$\underline{X} > 117{,}61$	Very Feasible
2.	$95{,}2 < \underline{X} \leq 117{,}61$	Feasible
3.	$72{,}8 < \underline{X} \leq 95{,}2$	Decent Enough
4.	$50{,}93 < \underline{X} \leq 72{,}8$	Not Feasible
5.	$\underline{X} \leq 50{,}93$	Very unfeasible

Calculation of material expert questionnaire assessment :

$$\underline{X} = \frac{\Sigma x}{N}$$
$$= \frac{138}{1}$$
$$= 138$$

So, the assessment results from the material expert are 138> 117.61, including the criteria ‘Very Feasible’.

b) Media Expert Validation Test Results

c)

Table 8. Media expert validation test results

No.	Aspect	Media Expert 1					Media Expert 2					Total Score
		1	2	3	4	5	1	2	3	4	5	
1.	Layer Design Display			3		15				4	15	37
2.	Ease of Operation					20					20	40
3.	Consistency				4	10					15	29
4.	Format				8						10	18
5.	Sound					10					10	20
6.	Navigation					5				4		9
7.	Usability				8	10					20	38
8.	Animation				4	20					25	49
	Total Score											240
	Average											120
	Criteria											Very Feasible

The table above shows the assessment results from two media experts regarding the feasibility of learning media. There are eight aspects assessed, with each score from two media experts. Here are the details of each part of the table:

1. Aspect: Categories assessed, including:
   - Layer Design Display assesses the design appearance of the media layers, with scores from each expert of 3, 15, 4, and 15, for a total of 37.
   - Ease of Operation: Assessing the ease of use of the media, with the score from the first expert being 20 and from the second expert also 20, resulting in a total of 40.
   - Consistency: Assessing design consistency, with scores from the first expert being 4 and 10, and from the second expert being 15, resulting in a total of 29.
   - Format: Assessing the information presentation format, with a score of 8 from the first expert and 10 from the second expert, resulting in 18.
   - Sound: Assessing audio quality in the media, with a score of 10 from the first expert and 10 from the second expert, resulting in a total of 20.
   - Navigation: Assessing the ease of navigation in the media, with a score of 5 from the first expert and 4 from the second expert, resulting in a total of 9.
   - Usability: Assessing the level of usability of the media in learning, with scores from the first expert being 8 and 10, and from the second expert being 20, resulting in a total of 38.
   - Animation: Assessing the quality of animation in the media, with scores from the first expert being 4 and 20, and from the second expert being 25, resulting in a total of 49.
2. Total Score: The total number of scores from all aspects assessed, which in this case is 240.
3. Average: The average score obtained, which is 120, indicates that the assessments from both media experts are fairly consistent.
4. Criteria: The eligibility criteria are based on the total score. In this table, the criteria indicate that the learning media is rated Very Feasible, which means that it is very feasible to use in learning.

Overall, this table reflects the two media experts' positive assessment of the learning media, indicating that the media is good quality and suitable for use in an educational context. After the data from the media expert, the average value obtained matches the media expert's eligibility criteria table. The eligibility criteria can be seen in the following table:

Table 9. Media Expert Feasibility Criteria

No.	Qualitative Score Range	Qualitative Criteria
1.	$\underline{X} > 104{,}9$	Very Feasible
2.	$84{,}99 < \underline{X} \leq 104{,}9$	Feasible
3.	$65{,}01 < \underline{X} \leq 84{,}99$	Decent Enough
4.	$45{,}02 < \underline{X} \leq 65{,}01$	Not Feasible
5.	$\underline{X} \leq 42{,}02$	Very unfeasible

Calculation of media expert questionnaire assessment:

$$\underline{X} = \frac{\Sigma x}{N}$$
$$= \frac{240}{2}$$
$$= 120$$

So, the results of the media expert's assessment are 120> 104.9, which is included in the 'Very Feasible' criteria.

d) Student Response Test Results

Table 10. Student response test results

No.	Aspect	Student					Total Score
		1	2	3	4	5	
1.	Presentation of Material		10	57	112	265	444
2.	Language		4	33	56	165	258
3.	Graphics	1	12	48	116	265	442
4.	Benefits		10	60	96	205	371
	Total Score						1515

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Average	101
Criteria	Very Feasible

The table above presents the results of 15 students' assessment of the learning media, focusing on four aspects. Here are the details of each part of the table:

1. Aspect: Categories assessed, including:
   - Presentation of Material: Assessing the way the material is presented. The score from students totaled 444, indicating that students rated the presentation of the material as excellent.
   - Language: Assessing the clarity of the language used in the material. The total score was 258, indicating a good level of language understanding.
   - Graphics: Assessing the quality of the graphical elements. The total score is 442, reflecting that the graphics are considered attractive and support the delivery of the material.
   - Benefits: Assessing the benefits of the learning media. The total score is 371, indicating that students feel this media provides significant benefits in learning.
2. Total Score: The total score for all aspects assessed is 1515.
3. Average: The average score obtained from the student's assessment is 101, indicating that overall, the students rated the learning media as good.
4. Criteria: The eligibility criteria are based on the total score. In this table, the criteria indicate that the learning media is rated Very Feasible, which means that the media is very feasible to be used in learning.

Overall, this table reflects positive feedback from students, indicating that the learning media is effective in helping them understand the material well. After the data is obtained from students' responses, the average value obtained matches the eligibility criteria table for student responses. The eligibility criteria can be seen in the following table:

Table 11. Eligibility Criteria for Student Responses

No.	Qualitative Score Range	Qualitative Criteria
1.	$\underline{X} > 100{,}8$	Very Feasible
2.	$84{,}99 < \underline{X} \leq 104{,}9$	Feasible
3.	$65{,}01 < \underline{X} \leq 84{,}99$	Decent Enough
4.	$45{,}02 < \underline{X} \leq 65{,}01$	Not Feasible
5.	$\underline{X} \leq 42{,}02$	Very Unworthy

Calculation of student response questionnaire assessment:

$$\underline{X} = \frac{\Sigma x}{N}$$
$$= \frac{1515}{15}$$
$$= 101$$

So, the assessment results from student responses are 101> 100.8 included in the 'Very Feasible' criteria. Based on the material expert feasibility test results, the number of scores '138' with an average of '138' is included in the 'Very Feasible' criteria. The results of the media expert feasibility test obtained a total score of '240' with an average of '120' including the criteria 'Very Feasible', and the results of the student response test obtained a total score of '1515' with an average of '101' including the category 'Very Feasible,' It can be concluded that android-based interactive learning media is suitable for use in the learning process.

3.2. Discussion

The final product results in this study are Android-based interactive learning media on computer assembly material, which contains material content, images, animations, videos, audio, computer assembly simulations, and quizzes. Adobe Animate CC software makes this learning media. This learning media has gone through all stages of the ADDIE development model, starting from Analysis, Design, Development, Implementation, and Evaluation.

The first stage is analysis, which identifies what students will learn and analyzes the needs for developing interactive learning media based on Android. At this stage, the researcher conducts a needs analysis by conducting field observations and interviews regarding learning computer assembly material. This activity is in the form of collecting data about the learning conditions at SMK Negeri 1 Lolayan Class

X. The second stage is design; at this stage, the researcher designs the initial display of interactive learning media based on Android by making flowcharts and storyboards. The third stage is development; at this stage, the researcher starts developing interactive learning media based on Android using Adobe Animate CC software, starting from creating content (material, animation, learning videos, quizzes, and assembly simulations). After the interactive learning media based on Android is made, the next process is testing to determine whether the buttons and content on interactive learning media based on Android function properly. After successful testing, material, and media experts will validate interactive learning media based on Android. The fourth stage is implementation; at this stage, testing interactive learning media based on Android is carried out to class X TKJ students of SMK Negeri 1 Lolayan, totaling 15 students. Students download and install interactive learning media based on Android using the Google Drive link that has been shared. Then, the researcher introduced the features of interactive learning media based on Android. After students understand how to use interactive learning media based on Android, the researcher distributes a questionnaire questionnaire of student responses and directs students to fill out the questionnaire. The final stage in this development is evaluation; at this stage, the researcher processes the data from the student response questionnaire to determine whether the Android-based interactive learning media is easy to understand and relevant.

Based on the results of the feasibility test of material experts obtained a total score of '138' with an average of '138' including the criteria 'Very Feasible,' the results of the feasibility test of media experts obtained a total score of '240' with an average of '120' including the criteria 'Very Feasible', and the results of the student response test obtained a total score of '1515' with an average of '101' including the category 'Very Feasible,' It can be concluded that android-based interactive learning media is feasible to use in the learning process.

4. CONCLUSION

Based on the results of the research that has been done, it can be concluded that the development of interactive learning media based on *Android* produces applications in the form of interactive learning media based on *Android* with the results of feasibility testing by media experts obtained an average value of '120' with the criteria 'very feasible,' and the results of feasibility testing by material experts obtained an average value of '138' with the criteria 'very feasible' and the results of testing student response responses obtained an average value of '101' with the criteria 'very feasible.'

Android-based interactive learning media has a positive impact on class X TKJ students at SMK Negeri 1 Lolayan; based on the problems written in the background that students do not understand computer assembly material because the media used is *PowerPoint* media, which only contains text, this results in students failing to carry out practicum during the exam because one of the computers is damaged. This *android-based* interactive learning media contains computer assembly material, *drag-and-drop* simulation of computer components into the appropriate *ports* on the motherboard, quizzes on each subject matter, and quizzes covering all subject matter. With this, *Android-based* interactive learning media answers the problem by helping students understand computer assembly material better.

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