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Mobile-Based Learning Media Using Open Ended Learning Approaches to Increasing Students' Interest in Basic Programming Subjects of Vocational Schools

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ABSTRACT

The current developments have ease in accessing information which is a challenge for students. One form of development of the times is the use of smartphones, where these smartphones can be used by students in accessing learning resources to assist the learning process. This research utilizes the use of this smartphone to design a mobile-based learning media using the Design Thinking development method to determine the feasibility of learning media applications on basic programming materials using the Open-Ended Learning approach and to determine the level of interest in learning of senior high school student's competency skills in Software Engineering with using a Likert scale of 4 and the User Experience Questionnaire (UEQ) method. The data collection process was carried out by distributing questionnaires to media experts, material experts, small group tests and field tests. It is hoped that this learning medium will provide a good experience for users. The conclusions obtained in the media expert validation test produce an average percentage value of 84.7 percent and in the material expert validation test produce an average percentage value of 85.00 percent. The small group produced the highest scale on stimulation with an average of 1.95 and the smallest scale on novelty with an average of 1.28. The field test produced the highest scale on stimulation with an average of 2.01 and the smallest scale on novelty with an average of 1.47. And the interest level test produces an average value of 80.68 percent which is a high interest category.

I. INTRODUCTION

The development of the times that occur cannot be denied, where this is a factor in the rapid advancement of technology that facilitates the activities of an individual. One example is the development of smartphones, which have become an individual need in carrying out daily activities. Smartphone is a portable technology in which there is a built-in microprocessor, memory, layer and modem [1]. Smartphone is also a multimedia technology that can perform various functions in it.

Access to learning resources in the current conditions of technological development is very broad, where students can access via the internet anywhere and anytime, this can be related to a survey conducted by the Ministry of Communication and Information HR Research and Development regarding the percentage level of internet use that has reached 36.1% for learning and for information search reached 61.01%

Self-learning resources include all resources related to data, people, goods, and elements that allow their use individually or in combination, and which students usually use optimally to provide basic materials for learning activities. In

terms of education, learning resources are very helpful in the learning process that occurs. Where learning resources can be a reference material for students in finding the material needed easily. Learning Resources

This can be developed into a learning medium in which the material on learning resources is arranged in an integrated and coherent manner to attract students' interest [2].

"Open Ended Approach" According to melianingsih and Sugiman [3], namely a learning approach that demands an open mindset, the thinking processes of students do not only focus on one process or result. In the Open-Ended approach, the purpose of giving problems is not to find answers but to find different strategies, ways and approaches to arrive at answers to the problems given.

The application of the Open-Ended approach to students who are taking Basic Programming subjects to increase interest lies in its application where learning with an Open-Ended approach is able to help students realize a way of learning that is not only focused on one process or result, but with the aim that students can find different methods in solving the given problem. Thus learning the Open-Ended approach to students can increase students' interest in learning basic programming subjects and be able to think openly.

Like the details of the problems above, the use of media that is too monotonous can affect the learning process. This problem provides an idea to create an Android-based learning media with an Open-Ended approach in Basic Programming subjects which is expected to have an impact on learning in Software Engineering Skills Competency Vocational Schools.

Research on mobile-based learning media has been carried out by several other researchers. Apri Widodo and Yusman Wiyatmo in 2017[4] developed an android-based digital pocketbook learning media to increase interest in learning. In the research conducted by Apri, media validation tests were carried out, lesson plans validation, student response results, and analysis of increasing interest and learning outcomes. This study has high category results on increasing interest in learning from before using the application which is 2.79 while the average value after using it rises to 3.41. However, in this study there are still limitations, namely the application is offline so it cannot be updated.

Other research was conducted by Aris Sudianto and Lalu Muhammad Samsu in 2019 [5]. In this study developed interactive learning media as an effort to increase students' learning interest. This study has the conclusion that the use of interactive learning media is more effective than conventional learning methods. This Android-based learning media application is easy to use and flexible in its use, and the media can be used with teacher guidance or independently by students.

Calvin Talakua and Sovian Sesca Elly in 2020 [6] developed mobile learning-based biology learning media to determine the influence of interest and creative thinking abilities of high school students in Mahosi City. This study has the result that mobile learning-based learning media can increase interest in learning, as evidenced by the average pretest score of 73.67 and post-test increased to 80.22. The results of the hypothesis test obtained a calculated F value of 10.266 with a probability value (p) of 0.000 or less than 0.05, which means that Mobile Learning-based learning has an effect on the learning interest of high school students in Masohi City. Furthermore, based on the results of research on students' creative thinking abilities, it was obtained that learning information based on Mobile Learning was higher than the control class. The results of the hypothesis test obtained a calculated F value of 42,376 with a probability value (p) of 0.000 or less than 0.05, which means that Mobile Learning-based learning has an effect on the creative thinking abilities of high school students in Masohi City.

This research develops mobile-based learning media using the Open Ended Learning approach to increase students' interest in learning. Open Ended Learning was chosen in this study because it has the advantage of being able to increase the activeness of students in learning and have more opportunities to utilize knowledge and skills in a comprehensive manner. The developed learning media has several features including learning materials, exercises, learning videos, and evaluation quizzes.

II. METHODS

This study uses the Design Thinking method which has 5 stages, namely 1) Empathize; 2) Define; 3) Ideate; 4) Prototypes; 5)Test [7]. These stages were then developed according to the problems encountered during surveys and observations.

A. Empathize

In the empathize stage, a survey was conducted at several RPL majoring Vocational Schools, focused on basic programming subjects. It can be concluded that in the software engineering sub-competence, namely basic programming, flexible learning materials or media are needed for use by students outside of classroom learning. which is limited to learning branching, looping, and function control structures.

B. Define

In the defined stage, the aim is to analyze and understand the results obtained from the previous stages. It is concluded that students in learning basic programming, especially material for branch control structures, repetition, and functions, require (1) mobile-based learning media, (2) learning media that can facilitate students in the process of understanding the material, (3) learning media that can encourage students to be able to solve the problems they face.

C. Ideate

In the ideate stage, the process of generating ideas is carried out to solve the problems described in the previous stages. This process determines the material to be used. Designing learning scenarios, learning tools and tools for evaluating media. The application of the open-ended approach here is placed on the features of the learning material.

D. Prototypes

At this stage, the material that has been selected will be developed and will be designed in an open-ended approach. The application interface design is made using Adobe XD software. While the application build is developed using modular. The assets used come from free sources on the internet.

E. At the test stage

A trial process is carried out. Product implementation is used to obtain feedback on products that have been developed. The implementation of the quiz and exercise features in the application was tested to find out whether it was running well or not. Students will be directed to find problems, then by using the application made, students will try to solve these problems by accessing the material provided. Students can see the results of the evaluation at the end of learning after doing quizzes or exercises.

Testing this development uses subjects adapted to sampling, which include: (1) The validity test is carried out by lecturers who are experts in learning media and material experts, namely teachers who teach basic programming subjects at SMKN 12 Malang; (2) Small group feasibility test of 10 students of class XI RPL SMKN 12 Malang; and (3) Large group adequacy test and measurement of interest in learning were carried out on 31 students of class XI RPL SMKN 12 Malang.

This research will use quantitative and qualitative data types. Quantitative is data that contains numbers obtained after distributing questionnaires to material experts, media experts and student respondents. While qualitative is data in the form of interviews, responses, suggestions or criticism from experts and student respondents. The selected data collection instruments for development research were questionnaires / question forms and the User Experience Questionnaire (UEQ). The scale used is the Likert scale.

Media and material validation results were obtained by calculating values using the rating scale criteria [8], while the assessment criteria are presented in Table 1. The rating scale formula (1) calculates the percentage value which is an indicator of the level of validation of research success.

$$P = \frac{SHP}{SI} \; x \; 100\% \quad (1)$$

TABLE I. MEDIA AND MATERIAL CRITERIA FEASIBILITY

Validity Criteria	Validity Level	Information
75,01% - 100,00%	Valid	feasible to function without revision
50,01% - 75,00%	Quite Valid	Feasible to function, need minor revision
25,01% - 50,00%	Less Valid	Not feasible to function, need major revision
00,00% - 25,00%	invalid	Should not be user

TABLE II. CRITERIA FOR INTEREST IN LEARNING LEVEL

Interest Criteria	Interest Category	Information
80,01%-100,00%	High Interest	Interest generated is high
60,01%-80,00%	Sufficient Interest	The interest generated is enough
40,01%-60,00%	Low Interest	Interest generated is low
00,00%-40,00%	Very Low Interest	Interest generated is very low

Where, P is validity score, SHP is the total score of the questionnaire, and SI is the maximal score. The feasibility questionnaire data was analyzed using the User Experience Questionnaire (UEQ). From this use conclusions will be obtained from each rating scale consisting of bad, below average, above average, good, and excellent. Interest in learning questionnaire data is calculated using a rating scale formula (1) with the criteria as an assessment in Table 2.

F. Maintaining the Integrity of the Specifications

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III. RESULT AND DISCUSSION

This development research produced a mobile-based learning media product for basic programming subjects with the name "Open PD". This media was developed using the Open Ended Learning model of class XI Vocational School students Software Engineering Skills Competency. The materials presented are (1) branch control structure; (2) Loop control structure; (3) Use of functions. "Open PD" was tested with two stages of testing, namely the expert validation stage which consisted of material validation and media validation, and the second stage of due diligence which consisted of small group trials and large group trials. Media "Open PD" learning consists of several pages, namely the main menu page, materials, quizzes, about us, exercises, learning videos, about the developer, and about the application. There are three main pages, namely: (1) The material in Fig 1. is a page that will appear after the splash screen when the user opens the application, displaying several sub-materials for students to study; (2) Quiz in Fig 2, evaluation questions presented from a mixture of material provided in which there are multiple choice questions with 5 answer choices below the questions, as well as the results of the evaluation after students work on the questions; and (3) About us in Fig 3, contains the application and the developer, the about application page contains an explanation of the buttons in the application, and the developer's profile contains the developer's profile.

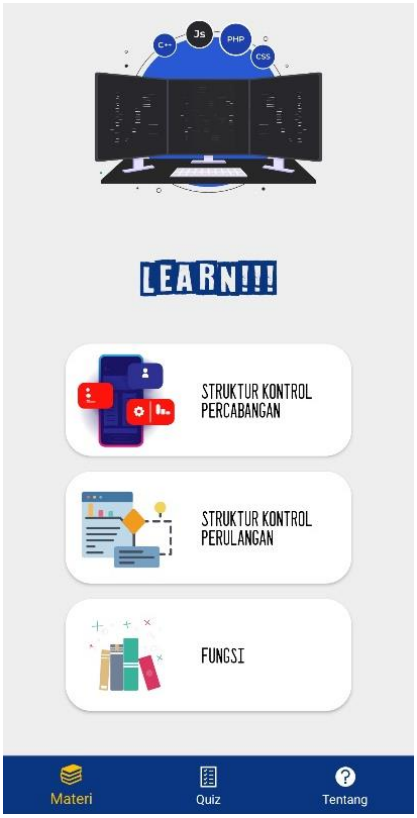

Fig. 1. The Material page.

Fig. 2. The quiz page

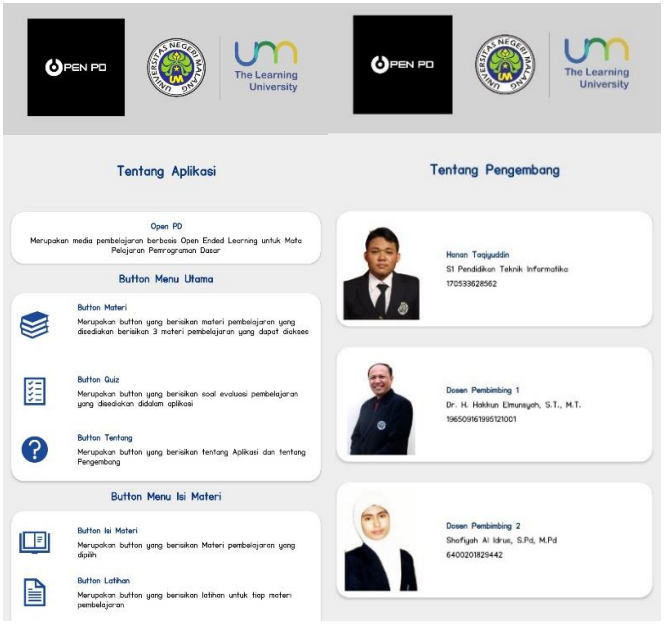

Fig. 3. About us page

TABLE III. MEDIA EXPERT VALIDATION RESULT

No	Assessment Aspects	SHP	SI	P (%)
1	Instructional Quality	28	32	87,50 %
2	Media	33	40	82,75 %
		61	72	84,72%

Learning media validation uses rating scale analysis. The SHP value obtained was 54 with SI was 72 according to [9] the results obtained were 75% and if it was categorized into the validity level criteria, the developed media was stated to be quite valid and feasible to function with minor revisions. With input in the form of improving the appearance of the training bottom menu, layout of the quiz on the answer choices, as well as the about us feature, it is necessary to add an explanation about the application. After the revision was carried out and obtaining an SHP value of 61 with an SI of 72. The results obtained after the revision were 84.72% so that it was included in the valid category and was feasible to function without revision. The following is a summary of the validation results presented in Table 3.

Based on the results of the first media expert validation, namely from the aspect of instructional quality as assessed by several indicators namely: (1) Providing learning opportunities, (2) providing assistance for learning, (3) quality, (4) flexibility, (5) relationship, (6) social quality, (7) the quality of tests and assessments, (8) and can have an impact on students and teachers in the learning process. In this aspect media experts argue that the product developed has a balance in delivering material that users can use to study flexibly and the quality of the questions given is also feasible to be presented to users. This instructional quality has a percentage value obtained from media experts of 87.50%. This is in line with research that has been conducted where valid media is media that has balance and completeness in terms of

material content, for example from material, learning objectives, and completeness of the guide in the application. This indicates that the teaching materials are very valid from the aspect of instructional quality [10].

The media aspect is assessed from several indicators, namely: (1) Readability, (2) ease of use, (3) quality of display, (4) quality of response handling, (5) quality of program management, and (6) quality of documentation. The percentage obtained is 82.50% which indicates that the teaching material is very valid from the media aspect.

Validation of learning materials using rating scale analysis. The SHP value obtained is 68 with SI is 80 according to the results obtained are 85% and if categorized into the criteria for the level of validity then the material presented in the media can be declared valid and feasible to function without revision [11]. The following is a summary of the validation results presented in Table 4.

Aspects of the quality of content and objectives are assessed from several indicators, namely: (1) Relevance of objectives, (2) accuracy of material, (3) sequence of material, (4) accuracy of language. balance of material and questions. The percentage obtained is 79.16% which indicates that the teaching material is very valid from the material aspect. The content aspect of the material is assessed from several indicators, namely: (1) the suitability of the material, (2) the accuracy of the examples, (3) the scope of the material, and (4) the order of the material. The percentage obtained is 88.89% which indicates that the teaching material is very valid from the aspect of the questions. The evaluation aspect is assessed from several indicators, namely: (1) evaluation clarity, (2) evaluation suitability, and (3) material balance with questions. The percentage obtained is 85.00%, which indicates that the teaching material is very valid from a linguistic aspect.

The implementation of small group trials was carried out on 10 students from SMK Negeri 12 Malang with software engineering expertise competencies. Data taken from this small group trial used the User Experience Questionnaire (UEQ).

Testing the reliability of data by checking the Cronbach Alpha coefficient. The Cronbach Alpha coefficient describes the consistency for all items on the scale. A data can be said to have high consistency if the value of the Cronbach Alpha coefficient is greater than or equal to 0.7. in Table 5 shows the reliability of Cronbach Alpha on each scale. The scale shows that the value of the Cronbach Alpha coefficient is greater than 0.7.

TABLE IV. MATERIAL EXPERT VALIDATION RESULT

No	Assessment Aspects	SHP	SI	P (%)
1	Quality of content and purpose	19	24	79,16%
2	Content Material	32	35	88,89%
3	Evaluation	17	20	85,00%
Total		68	80	85,00%

TABLE V. SMALL GROUP RELIABILITY TEST RESULTS

Scale	Cronbach Alpha
Attractiveness	0,91
Perspicuity	0,93
Efficiency	0,90
Dependability	0,96
Stimulation	0,97
Novelty	0,91

TABLE VI. SMALL GROUP RELIABILITY TEST RESULTS

UEQ Scales (Mean and Variance)		
Attractiveness	↑ 1,900	0,62
Perspicuity	↑ 1,900	0,98
Efficiency	↑ 1,850	0,64
Dependability	↑ 1,625	1,43
Stimulation	↑ 1,950	1,69
Novelty	↑ 1,275	1,35

After knowing the results of the reliability test. Then do the calculation of the mean and variance on the respondent's answer data. Table 6 is the result of calculating the Mean and Variance. The mean is the average of all respondents' responses while the Variance shows the variation in the distribution of the data.

Table 6 shows the results of calculating the Mean and Variance. Of the six scales calculated, a positive evaluation is marked with an arrow up. After knowing the meaning, a comparison is needed with products that have used UEQ as a test method and the benchmark table can be compared with data from the benchmark data set, which can be seen in Fig 4 and Table 7.

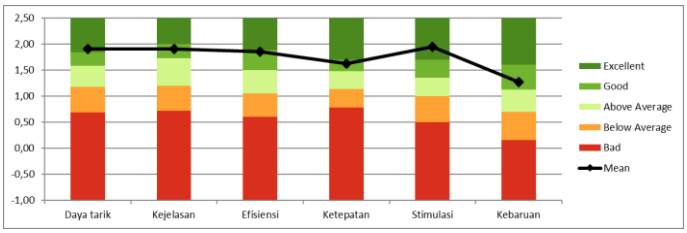

Fig. 4. Small group UEQ Benchmark chart

TABLE VII. SMALL GROUP BENCHMARK TEST

Scale	Mean	Comparison to benchmark	Interpretation
Attractiveness	1,90	Excellent	In the range of the 10% best results
Perspicuity	1,90	Good	10% of results better, 75% of results worse
Efficiency	1,85	Good	10% of results better, 75% of results worse
Dependability	1,63	Good	10% of results better, 75% of results worse
Stimulation	1,95	Excellent	In the range of the 10% best results
Novelty	1,28	Good	10% of results better, 75% of results worse

In Fig 4 the six UEQ scales can be seen that attraction and stimulation have excellent results and the other four scales namely clarity, efficiency, accuracy, and novelty have good results. The best rating is on the stimulation scale and the lowest is on novelty.

After knowing the results of the UEQ in the small group test, it was continued with field tests on 31 students of SMK Negeri 12 Malang, competency in software engineering skills. The stages carried out are the same as the small group test, namely using the User Experience Questionnaire (UEQ) with the addition of a limited learning interest test only to find out the percentage of interest after using learning media applications. The following are the results of calculations for the field test group in Table 8 in the form of the reliability test and Table 9 of the Field Test UEQ Scale.

Table 9 has positive results such as the small group test. However, to find out more results, a comparison is made with products that have used UEQ as a test method, which can be seen in Fig 5 and Table 10.

In Fig 5 the six UEQ scales can be seen that attractiveness, precision, and stimulation have excellent results, two scales, namely efficiency and novelty, have good results and 1 scale, namely clarity, has results above average. The best rating is on the stimulation scale and the lowest is on novelty.

TABLE VIII. FIELD RELIABILITY TEST RESULTS

Scale	Cronbach Alpha
Attractiveness	0,95
Perspicuity	0,94
Efficiency	0,95
Dependability	0,93
Stimulation	0,91
Novelty	0,94

TABLE IX. FIELD TEST UEQ SCALE

UEQ Scales (Mean and Variance)		
Attractiveness	↑ 1,882	1,23
Perspicuity	↑ 1,565	2,09
Efficiency	↑ 1,855	1,32
Dependability	↑ 1,702	1,95
Stimulation	↑ 2,008	1,24
Novelty	↑ 1,468	2,02

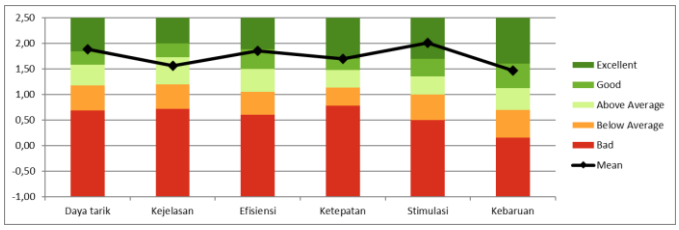

Fig. 5. Field test group UEQ Benchmark chart

TABLE X. FIELD TEST GROUP BENCHMARK TEST

Scale	Mean	Comparison to benchmark	Interpretation
Attractiveness	1,88	Excellent	In the range of the 10% best results
Perspicuity	1,56	Above Average	25% of results better, 50% of results worse
Efficiency	1,85	Good	10% of results better, 75% of results worse
Dependability	1,70	Excellent	In the range of the 10% best results
Stimulation	2,01	Excellent	In the range of the 10% best results
Novelty	1,47	Good	10% of results better, 75% of results worse

TABLE XI. DATA ON THE TEST RESULTS OF INTEREST IN LEARNING

No	Assessment Aspects	SHP	SI	P (%)
1	Happy	692	868	79,72%
2	Student Involvement	502	620	80,97%
3	Interest	599	744	80,51%
4	Student attention	508	620	81,94%
Total		2301	2852	80,68%

The interesting test process was carried out for one class with a total of 31 students who had taken KIKD 3.6, 3.7 and 3.9 basic programming subjects. The results of the learning interest test data will be categorized by the criteria for the level of motivation. The interest test process produces an average percentage of 80.54% which indicates that teaching material products can increase the interest of students with a high level of interest category [[12], [13]. One of the criteria for good teaching materials is teaching materials that arouse the desire and interest of students to learn [14], [15]. The following is a summary of the results of the learning interest test in Table 11.

1) The happy criterion takes 7 out of 23 questions, namely on questions number 1 to 7 with a total score of 692 respondents out of a maximum score of 868, so that a percentage value of 79.72% is obtained which indicates a moderate interest category. 2) The criteria for student involvement took 5 of the 23 questions, namely questions number 8 to 12 with a total respondent score of 502 out of a maximum score of 620, so that a percentage value of 80.97% was obtained which indicated a high interest category. 3) The interest criterion takes 6 of the 23 questions, namely on questions number 13 to 18 with a total respondent score of 599 out of a maximum score of 744, so that a percentage value of 80.51% is obtained which indicates a high interest category. 4) The criteria for students' attention took 5 of the 23 questions, namely on questions number 19 to 23 with a total respondent score of 508 out of a maximum score of 620, so that a percentage value of 81.94% was obtained which indicated a high interest category.

IV. CONCLUSION

Based on the results obtained from the research that has been done, it can be concluded to answer the research and

development objectives: 1) The learning media product developed in this study has an application name, namely Open PD which was developed using Kodular. Using the Design Thinking development method which has 5 stages, namely empathize, define, ideate, prototype, and test. Products developed using the Open-Ended approach to increase students' interest in learning software engineering competency skills. 2) The feasibility of learning media products that have been developed under the name Open PD has a valid validation level, where applications containing basic programming material with an Open Ended approach have the eligibility to be used as additional learning media for students. Products that have been developed and tested on students give the result that the level of interest in learning produced is 80.68% which is included in the high category of interest

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