Development of Mobile Based Educational Game as a Learning Media for Basic Programming in VHS

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***Abstract*—The purpose of this research is to develop mobile based education game which will be used as the learning media of basic programming for grade X VHS student as well as to know the its eligibility level. The developed education game consists of four basic programming competencies. This learning media is developed using ADDIE model with waterfall model for the flow development. The validation process involved 2 material experts, 1 media expert, and two groups of eligibility testing. The type of data is qualitative and quantitative with the method of data collection is questionnaire. The measurement uses five scale of likert. This study concluded that the developed educational game are valid and eligible to be used as a basic programming learning media.**

Keywords—Educational Game, Mobile, Basic Programming, VHS.

I. INTRODUCTION

Students of computer and information technology in vocational high school (VHS) are demanded to have the basic skill in programming. In fact, some schools depends on BSE (*Buku Sarana Elektronik*) which is unpracticable and not suitable with the 2013's curriculum 2013 (revision 2017). Furthermore, the other obstacles are related to the limitation of material source. The limited material source come from their teacher without other learning media as the material source[1].

The conventional learning process only focus on students' cognitive aspects. The teacher uses a book as the main source of information. As a result, the student may feel bored to the subject[2]. It may directly affect the student's learning outcomes. Based on observation, in 1st daily test (3rd and 4th competency) only 27% of 60 students passed those daily test and in 3rd daily test (6th competency) only 45,9% of students passed those daily test. It has been proven that the conventional learning process method still give a problem to student learning outcomes.

One of ways to enhance the leaning outcome is the use of learning media. Learning media may enable student self motivation to study and understand the material [3]. The form of learning media can be picture, audio, video, animation, props, simulation tool, education game, and other media.

Educational game is one form of learning media which combine education with entertainment. In an educational game consist of multimedia elements such as picture, audio, and animation. Learning process through educational game media can help student more interested to study and make student feel pleases without fell coercion to study. Playing games makes them more enthusiastic, relaxed, happy, and comfortable in following the lessons[4]. On the other side, the usage of smartphone increase time by time. Based on the quistionaire, 59 of 60 Vocational High School students already have a minimum Android Jelly Bean smartphone. Unfortunately, the increase of smartphone users is not maximally used in learning process by teacher. Therefore, mobile based learning media can be implemented as the potential sollution for improving the learning process. The development of this media using ADDIE model (Analysis, Design, Development, Implementation, and Evaluation).

II. THEORETICAL BASIS

A. Research and Development

Research and development is a research method to produce a product and test the effectivity of this product[5]. Effectivity test is needed through a research to test the product which is can make this product can be usefell in wide society. The research activity get information about user needs and data analysis, while the development activity produce learning tools referring to the previous stage.

ADDIE stands for Analyze, Design, Develop, Implement, and Evaluate is a research and development model by Dick and Carey. The consept is being applied for constructing performance-based learning. ADDIE serves as guiding framework for complex situations, appropriate for developing educational products, and other learning resources[6]. The whole procedure of ADDIE model can be seen at Figure 1.

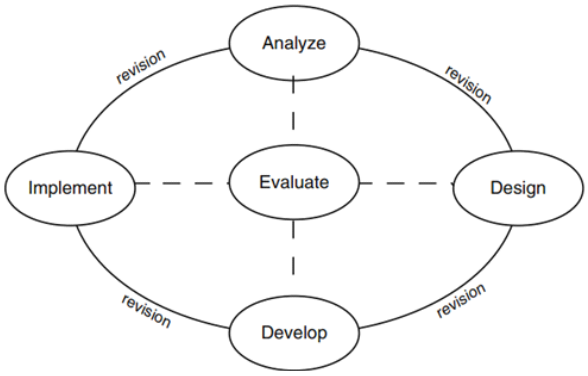

Fig. 1. ADDIE model

B. Basic Programming Subject

Basic programming is one of compulsory competency for computer and information technology VHS-students. In the structure of curriculum 2013 (revised in 2017), basic programming subject classified in basic group of vocation program (C2), consist of basic, must be passed by X grade before go deep into their competency skills.

The basic competency of this subject are 1) Applying flow of computer program logic; 2) understanding software for programming language; 3) applying flow of programming with stucture of computer programming language; 4) applying the used of data type, variabel, constant, operator, and expression; 5) applying operation of arithmatic and logic; 6) applying the branching structure control in programming language; 7) applying looping structure control in programming language; 8) analyze the usage of array to save the data in memory; 9) applying the usage of function; 10) applying user interface in application; 11) applying any kind of control structure in user interface application; 12) analyzing the construction of simple application with user interface based; 13) evaluating debugging in simple application; and 14) evaluating installer package in simple application.

C. Educational Game

Game is a system with artificial conflict where the player can interact with the system by using certain rules. Rules limit the player behavior and determine player. Game is used to play and use the certain technique and method which can give joyfull and inner satisfaction to its users[7].

Game with educational content better known as educational game. Educational game boost students' interest through the pleased material subject, to ease the students understanding. Educational game is a game for teaching the player [8]. Game with education genre intensively refers to the content and propose of the game[9].

III. Research Method

In this paper, the model of research and development model which used are ADDIE model. This model is used due to its detail process as well as easiness for implementation. There are five steps in this method and will be explain in the following sub-sections.

A. Analyze

Analyze is a step to analyze the needs and to adjust the real condition in field. In this step the activity consist of analyze the learning process, analyze the need, also analyze the competency and current curriculum.

B. Design

Design step have to give solution in the form of prototype or product depiction which will be developed. In this step the prototype be made related with formulation of learning goal, material lesson, form of exercise, also the content of game (storyboard, flowchart, game asset) which will be developed. In this step, the formulation of material lesson take 4 competency, there are 1) applying the use of data type, variable, constant, operator, and expression; 2) applying operation of arithmetic and logic; 3) applying the branching structure control in programming language; and 4) applying looping structure control in programming language. Material referred to module, book, and internet source. The design of game flowchart is showed in Figure 2. Asset of game consist of character, background, item, sound effect, and etc.

C. Development

Development step is a step where the product of educational game will be developed based on the developed prototype. Here, the main procedure is that to produce the content also develop the proponent learning media. This model give depiction the flow of product development sequentially which is start from 1) analyze; 2) design; 3) coding; and 4) testing.

In this step, alpha testing procedure is implemented to minimalize the failure in product and make sure game can be work suitable with gameplay and all of game asset can be work with well before tested to expertise / validator.

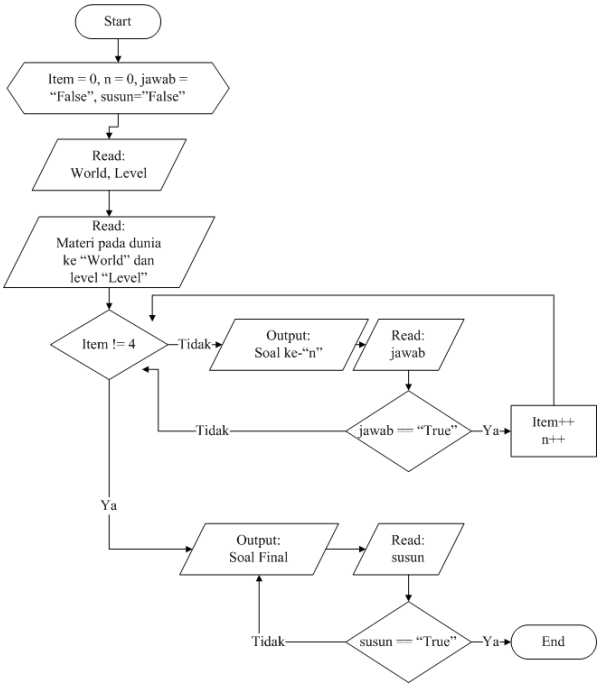

Fig. 2. Flowchart

D. Implementation

In implementation step, product should be validated by expertise / validator. Afterwards, product can be implemented and tested to students.

In validation process involves two experts: media and material experts. The propose of validation process is giving response or suggestion related to the product which being developed. Material expertises will judge the content and context of material lesson in product. Media expertise will judge functionality of the product.

Feasibility testing is executed by the VHS students. Eligibility testing done in 2 groups: big (30 students) and small groups (10-15 students) [5].

E. Evaluations

In research and development ADDIE model, evaluations step is the final step in whole of procedure. Basically,

evalutions step is always repeated. If there is any kind of improvement or missmatch sollution in every step of development, the data can be used as revision data through the development of the product.

F. Research Data

Based on preliminary observation data done to 60 student as respondents and 4 schools, the result are:

- Students have obstacles related to their logic skill.
- Students who passed basic programming subject only 25-40%.
- Students claim content in their modul and BSE less interactive, ilustratif, and only make bored.
- 59 of 60 student already have smartphone with minimal operating system are Android Jelly Bean.
- The current curricullum is curriculum 2013 revision 2017.

G. Data Collection

In this research, the used data are quantitative data and qualitative data. The method of data collection are questionnaire which is validate by advisors before given to expertise and respondent. The type of used questionaire is closed-questionaire and open-questionaire with measurement scale are likert scale consisting of five categories of choice [10]. Closed questionaire are the questionaire with the amount of item and alternative response already decided, so the respondent enough to choose under the real condition. Open questionaire used to give response from respondent such as review / suggestion / comment which can be respond freely.

The data analysis uses the formula percentage, where the results of these calculations were used to see the validity and eligibility of this product. Equation 1 is used to determine the percentage of validaty and eligibility for this product in each question and Equation 2 is used to determine the percentage of validation and eligibility for this product in total [11]. Table I shows the classification of validity level criteria and Table II shows the classification of eligibility level criteria.

TABLE I. VALIDITY CRITERIA BASED ON PRECENTAGE

Percentage (%)	Validity Criteria
85,01 – 100,00	Very Valid, or can be used without revision
70,01 – 85,00	Valid Enough, or can be used but need little revision
50,01 – 70,00	Less Valid, suggested not to used because need huge revision
01,00 – 50,00	Not Valid, or forbidden to used

TABLE II. ELIGIBILTY CRITERIA OF LEARNING MEDIA

Percentage (%)	Validity Criteria
82 – 100	Very Eligible
63 - 81	Eligible
44 - 62	Less Eligible
25 - 43	Not Eligible

$$V = TSe/TSh \times 100\% \quad (1)$$

Description:
V = Validity based on percentage
TSe = Total of empirik score
TSh = Total of maximal score

$$V = (\sum TSe)/(\sum TSh) \times 100\% \quad (2)$$

Description:
V = Validity based on percentage
$\sum$TSe = Amount of total empirik score
$\sum$TSh = Amount of total maximal score

IV. RESULT AND DISCUSSION

The game interface of the mobile based educational game of basic programming subject for X grade is presented in Figure 3.

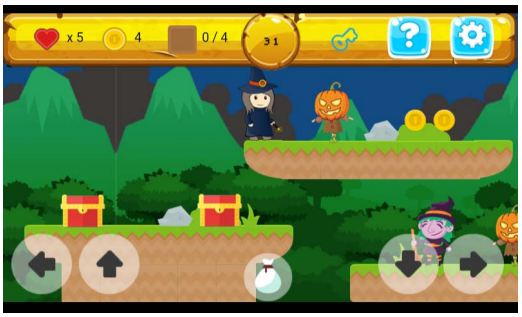

Fig. 3. Game Interface

Mobile based education game of basic programming has been developed used game engine software (Construct 2), Adobe photoshop CS6 is used to create game asset, Format Factory is used to change audio format, and Microsoft Office Visio 2007 as software used to make flowchart. This education game consist 4 competency with the final product is .apk extension and the minimum spesification product for the smartphone are:

- 1 GB RAM.
- Android Jelly Bean.
- Smartphone screen resolution are 480 x 800 pixel.
- 80 MB. of smartphone memory

Media expert validation data were obtained from questionaire given to the lecturer from Universitas Negeri Malang. The media validation process take 2 times in validation with the final results are shown in Table III.

According to table I on the validity criteria, the results obtained from the media expertise as a whole stated that the learning media used in the learning process are very good. In 1st validation, the average score obtained 84,5% with small revisions should be done The contain should be revised are (1) usability, (2) visual, and (3) layout and interface with the suggestions by the validator are (1) change game welcoming background, (2) give notification when the item are less, and (3) replace the controller. Based on those

result and suggesstion, we take revisions in our product and done the 2nd validation. In 2nd validation, the average score of the whole aspect of the assessment obtained 98,5%. Hence, it can be said that the media used in learning process are valid and don't require any revision.

TABLE III. MEDIA EXPERT VALIDATION

No	Asessment Aspect	∑Tse	∑Tsh	V (%)	Criteria
1	Software Engineering	64	65	98,5	Very Valid
2	Communication Visual	68	70	97,1	Very Valid
3	Learning Design	20	20	100	Very Valid
	Amount	152	155		
	Average			98,5	Very Valid

Material expert 1 validation data were obtained from questionaire, given to the lecturer from Universitas Negeri Malang. The final results of material validation 1 are shown in Table IV.

TABLE IV. MATERIAL EXPERT 1 VALDATION

No	Asessment Aspect	∑Tse	∑Tsh	V (%)	Criteria
1	Learning Design	103	105	98	Very Valid
2	Communication Visual	19	20	95	Very Valid
3	Software Engineering	10	10	100	Very Valid
	Amount	132	135		
	Average			97,8	Very Valid

Material expert 2 validation data were obtained from questionaire given to a VHS teacher, It takes two time of validation process in material expertise 2. The final results of material validation 2 are shown in Table V.

TABLE V. MATERIAL EXPERT 2 VALDATION

No	Asessment Aspect	∑Tse	∑Tsh	V (%)	Criteria
1	Learning Design	99	105	94,3	Very Valid
2	Communication Visual	19	20	95	Very Valid
3	Software Engineering	9	10	90	Very Valid
	Amount	127	135		
	Average			94,1	Very Valid

According to table I on the validity criteria, the results obtained from the material expertise as a whole stated that the material in learning media used to the learning process is very good. The average score of the whole aspect of the assessment obtained 97,8% from material expertise 1 and 94,1% from material expertise 2. Hence, it can be said that the material in media used for learning process are valid and don't require any revision.

Small group testing assess 15 VHS students using questionnaire The final results of small group are shown in Table VI.

The obtained results shows that the educational game used to the learning process is very good and eligible. The average score of the whole aspects is 89,5%. Hence, it can be said that the product are eligible and no revision needed.

TABLE VI. SMALL GROUP TESTING ASSESSMENT

No	Asessment Aspect	∑Tse	∑Tsh	V (%)	Criteria
1	Learning Design	882	975	90,5	Very Valid
2	Communication Visual	918	1050	87	Very Valid
3	Software Engineering	884	875	91	Very Valid
	Amount	2684	3000		
	Average			89,5	Very Valid

Big group assessment were obtained from questionaire, is given to 30 VHS students. The final results of small group are shown in Table VII.

TABLE VII. BIG GROUP TESTING ASSESSMENT

No	Asessment Aspect	∑Tse	∑Tsh	V (%)	Criteria
1	Learning Design	1793	1950	92	Very Valid
2	Communication Visual	1893	2100	90,1	Very Valid
3	Software Engineering	1881	1950	92,9	Very Valid
	Amount	5497	6000		
	Average			91,7	Very Valid

According to Table II , the results obtained from the big group assessment testing shows that product of educational game used to the learning process is very good and eligible. The average score of the whole obtained-assessment aspects is 91,7%. Hence, it can be said that the product are eligible and don't require any revision for learning process.

V. CONCLUSION

The developed mobile based educational game is a new innovation of learning media for VHS students. This media consist of 4 competency of basic programming subject. Based on experiments, it can be drawn that the developed educational game is eligible to use in learning process of basic programming.

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