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Development of Interactive Learning Media for Software Engineering Subject Chapter Process Modeling in Higher Education

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ABSTRACT

The software development process model or what is commonly called SDLC (Software Development Life Cycle) is one of the Software Engineering (RPL) course materials in the Information Engineering Education (PTI) undergraduate study program where one of the competencies is understanding and knowing the concepts of device engineering software that can be applied ins the software development life cycle which is summarized in the material for the SDLC software development process model. This material is the initial material that must be mastered by students to develop quality software. The use of interactive and interesting computer assisted learning media is expected to help the stages of the student learning process properly. This requires an interactive learning multimedia application. The purpose of this research is to develop interactive learning media as an alternative to independent learning tools to assist students in mastering the Software Development Process Model (SDLC) material for students and to find out the feasibility of multimedia application products for learning the Software Development Process Model (SDLC). The research and development methodology used in this research is Research and Development (R&D) with Borg and Gall's development steps which include: (1) Research and data collection; (2) Planning; (3) Development of product drafts; (4) Initial field trials; (5) Revision of trial results (6) Field trials; (7) Product improvement; (8) Field implementation test; (9) Completion of the final product; and (10) Dissemination of implementation. This methodology covers all matters relating to development to produce quality interactive learning media software. Based on the trials, the results obtained were 90.63% from media experts, 98.08% from material experts, 85.46% from initial field trials, 84.56% from field trials, and 86.27% from field implementation trials. The average value obtained is 89% based on the results of the overall data analysis. The conclusion of this research is that the development of multimedia applications for learning the Software Development Process Model (SDLC) is feasible as an independent learning medium. The product produced in this development research is a multimedia application for learning flash-based software development process (SDLC) models.

I. INTRODUCTION

In education, the development of information technology has begun to have a positive impact because the development of information technology, the world of education has begun to show significant changes [1]. Nowadays distance and time are not a significant problem in gaining knowledge, various applications are created to facilitate it. For the development of technology, there are many universities that can facilitate education in the field of technology, one of which is the state education university in the city of Malang, State University of Malang.

Universitas Negeri Malang (UM) is university organized by the Ministry of National Education of the Republic of Indonesia. UM organizes education to produce graduates who are superior and highly competitive in the field of vocational technology and engineering education. In the field of vocational technology and engineering education, UM has a special study program bachelor degree in Informatics Engineering Education to develop vocational technology education and science development in the field of informatics engineering supported by the standardized curriculum. This program aims to produce the graduates in the field of informatics engineering with undergraduate qualifications who are superior, professional, skilled, and sensitive to the preservation of the socio-cultural environment. The students' graduate of this program are also equipped with entrepreneur skills and knowledge that are in line with the development of informatics and computer science, especially in the field of engineering *software*.

The main competency that must be understanded by students is the competence in the field of *engineering*, namely *Software* Engineering which is manifested by students' skills in making software. These skills will be obtained from the Software Engineering course where one of the competencies is to understand and know software engineering concepts that can be applied in the software development life cycle, namely management and development processes, needs analysis, design and implementation, maintenance and testing that is packaged. in a software development process modeling material or sometimes also called SDLC (*Software Development Life Cycle*) [2]. Software process modeling is the initial material that students must master, because to create, develop, and produce quality software a developer requires a process model which is the process of developing or changing a software system using models or methodologies used by people. to develop software [3]. Therefore, after mastering this material, it is hoped that students can choose which SDLC model is appropriate and in accordance with the software being developed.

The main competency that must be understand by students is the competence in the field of *engineering*, namely *Software* Engineering which is manifested by students' skills in making software. These skills will be obtained from the Software Engineering course where one of the competencies is to understand the software engineering concepts that can be applied in the software development life cycle, (i.e., management and development processes, needs analysis, design and implementation, maintenance and testing) that is packaged in a software development process modeling material. It also called SDLC (*Software Deveopment Life Cycle*) [2]. Software process modeling is the initial material that students must be understand, because to create, develop, and produce a quality software, a developer needs a process model which is the process of developing or changing a software system using models or methodologies used by people to develop software [3]. Therefore, after understanding this material, students are expected to be able to choose SDLC model appropriate and in accordance with the software being developed.

Process modeling material is material that requires an illustration or description of the software development process which in the process requires student understanding and memory [4]. Visualization in the form of images or other visual media for process modeling material is one of the things that is also needed in delivering the material. Thus, the media factor needs to be optimized. Therefore, in the learning process, it is required to always be creative in creating a learning atmosphere, so that it will create fun learning and students become motivated to learn [5].

The purpose of this development is to develop interactive learning media as an alternative to help students understanding the software development process model (SDLC) material for students and to find out the feasibility of multimedia application products for the SDLC software development process model learning.

The product specifications for development and research are as follows: 1) The product is in the form of an interactive and attractive multimedia learning application that combines text, images, audio and animation components. 2) The product can be used for teaching or learning purposes for individual students. 3) The product runs *offline* on the operating system *windows*7.4) There are practice questions that are used to determine students' understanding of the material. 5) Using animated buttons and *backgrounds* adapted to the concept.

This study proposes a media development model for Research and Development Borg and Gall. This development model was chosen because it is simpler and has several stages where each stage aims to test the effectiveness of the media being developed. Research related to the development of instructional media has been carried out by several researchers, including Suleman et al. [6], Muhardi et al. [7], and Fani et al. [8]. Suleman et al. developed a media based on virtual reality in Chemistry subject. They used Research and Development model to develop the media. The effectiveness of the media produced in this study was 78% in the good category. Muhardi et al. using the Borg and Gall model as a media development technique. The media developed was Moodle. This Moodle-based learning media has proven to be effective. Fani et al. developing flash-based learning media for learning volleyball games. The method used in this research is Research and Development Borg and Gall. The results shown that the flash-based learning media was very effective in teaching volleyball games.

Based on the background above, this study proposes a Borg and Gall R&D development model as a media development method for producing effective media.

II. METHOD

The purpose of this development is to improve existing teaching media so as to create a new multimedia application product that is suitable for use as a learning medium. To achieve this goal, the development model used is research and development (*Research and Development*), namely the research method used to produce and test the effectiveness of a particular product " (Borg and Gall, 1983:775) [9].

This study uses the Borg and Gall development model because the model is relevant to this learning medium, especially in software development. This research also adopts this method from several previous studies, namely [6], [7], [8], dan [10]. The research and development steps by Borg and Gall that have been adapted to the needs of interactive learning media can be shown in Figure 1 [11].

The steps in development research according to (Borg and Gall, 1983: 775) are (1) Research and Information Gathering, (2) Planning, (3) Development of Initial Product Forms, (4) Initial Field Testing, (5) Product Revision Main, (6) Field Testing for Main Products, (7) Revision of Operational Products, (8) Field Testing of Final Forms, (9) Revision of Final Products, (10) Dissemination and Implementation.

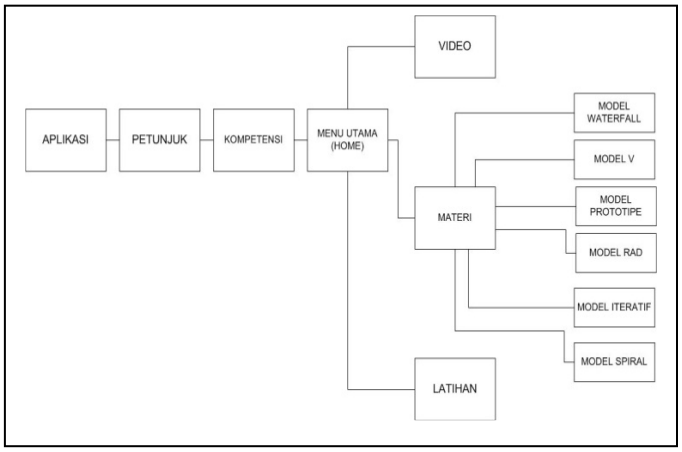

Fig. 1. Brainstorming Diagram of Interactive Learning Media

Through this diagram it can be understood that the sequence of the media presentation process begins with an opening page that contains a brief explanation of the learning media, instructions for use to explain media use, competencies containing learning objectives, material features, video features, and evaluation features . The material contains the software SDLC model material. *The video* shows a video about the process / life cycle in developing software. *Evaluation* contains questions related to the software development process model.

This learning media product development planning is represented through a block diagram to map the content covered in the learning media being developed. Figure 1 shows a brainstorming diagram of the software to be developed.

The interactive learning media product in the SDLC process model material consists of three features, namely material features, video features, and evaluation features.

The material feature contains a basic theory of the SDLC material process model In the material there is an illustration of the material with a display in the form of a sub-chapter illustrated image, then proceed with the material for each sub-chapter. The purpose of this material is to strengthen students' understanding of the SDLC process model. In addition, in this feature students are also given an introduction to concepts as a provision for students to move towards the next material.

The video feature contains a *video* of the software development process / lifecycle. The purpose of this feature is to strengthen student understanding.

The evaluation feature contains questions that students will work on regarding the material. By giving these questions, it is expected to what extent the students' understanding of the material conveyed through this interactive learning media.

At the planning stage, initial form development, and revision of learning media products were carried out in the Department of Electrical Engineering, Faculty of Engineering, State University of Malang for 3 months. The data collection stage, initial field testing, field trials, and field trials were carried out in the Electrical Engineering Department of the PTI study program for 2 months.

The product trial are used to collect data as a basis for determining the level of feasibility / validity of the media to be developed. This activity is carried out in stages.

A. Expert Testing

The media is tested first to the experts based on the analysis and logical considerations of the experts. To determine the feasibility level of the media that will be carried out by media experts and material experts: (1) The media experts is tested by lecturer in the Electrical Engineering department who are experts in the field of instructional media; (2) The material expert is tested by lecturer in RPL subject at Electrical Engineering majority.

B. Preliminary Testing

The preliminary product test is carried out after receiving input based on the evaluation results of media expert and material expert. This testing used to find the feasibility level of the media that will be carried out by students using a questionnaire. The test subjects were PTI's students with 13 students.

C. Field Testing

In this section, testing are carried out after receiving input based on the results of input from users in the

preliminary testing. This testing used to find out the feasibility level of the media to be carried out by students on a larger scale using a questionnaire.

D. The Real Testing

In this testing, there was no product improvement, because the product was considered perfect. This testing was carried out on other subjects with 84 students.

The instrument of readability of this teaching material is based on the Software Development Process Model (SDLC). The readability instrument contains a questionnaire to analyze the legibility of teaching materials in the Software Development Process Model (SDLC) subject. The questionnaire used is a type of questionnaire that contains a *rating scale*. *Rating scale questionnaire* is a questionnaire which contains questions followed by columns showing the levels [12]. The criteria, qualifications, and validity levels are shown in Table I [13].

TABLE I. PERCENTAGE ANALYSIS VALIDITY CRITERIA

Criteria	Qualifications	Validity Levels
80 - 100%	Valid	Good, No need revision
60 - 79%	Quite Valid	Good, Need a partial revision
50 - 59%	Less Valid	Good Enough, Partial revision and review of content
<50%	Invalid	Not Good, Totally revised or replaced

The media developed can be said to be successful and in accordance with the level of the eligibility criteria if it reaches the Valid criteria (80-100%).

III. RESULT AND DISCUSSION

This research produces learning media for the Software Development Process Model (SDLC) subject. The product developed of a flash-based application, which is used for PTI undergraduate study program. It obtained by applying the research and development methods mentioned in the method above. This learning media description consists of a description of the media and a description of the product being developed.

A. The Material Description

The product developed consist of three parts, such as material feature that consist of software material and SDLC model. It is completed by animation in each material to give illustration for students. Video used as feature to give explanation detail in that material for students. The evaluation feature is to determine the understanding and abilities of students after studying the material.

The material of this media concludes by any resource such as Simarmata, Janner (2010), Rosa and M. Salahuddin (2013), and Pressman, Roger S. (2010) [14]–[16].

B. Deskripsi Aplikasi

The media developed is multimedia application for SDLC process model learning. The learning media consist of 3 main pages, ie. (a) Material page; (b) Video page; and (c) Evaluation page. In the material page, there are 3 material choices that contain 2 introductory materials. There are softaware and software engineering. In other hand, the main material is SDLC proses model.

The interface design of main menu developed in this media consist of pictures and text view for make it easy to choose the learning media menu. This menu describes in Fig. 2.

Fig. 2. The Interface of Manin Menu

Product testing used to collect the data as a basic for find out the validation level of the media developed. The testing is carried out in stages, namely:

1. The Expert Testing

This testing is carried out by media and material expert, such as: 1) Media expert carried out by lecturer of Electrical Engineering, Universitas Negeri Malang, and 2) Material Expert carried out by software engineering's lecturer in Electrical Engineering, Universitas Negeri Malang.

2. The Preliminary Testing

The preliminary testing stage used to find out the eligibility product level of the media in the first stage. This testing carried out by 13 students in the PTI major using a questionnaire.

3. The Field Testing

This stage is a developed process to find out the eligibility level of media that carried out by students with the big scale using a questionnaire.

4. The Real Field Testing

This stage used to find out the developed media perform. There are 84 students in this stage as users who have never taken software engineering subject.

After going through several testing, researcher will describe the result testing clearly. The result of analysis data include: 1) validation of the expert media; 2) validation of material expert; 3) the preliminary testing; 4) the field testing; and 5) the real field testing.

The result of media expert validation finds out the software engineering aspect has average value as 87.5%, it

interprets that the media is valid. In other side, in the learning design aspect find out percentage as 91.67%, it means that the media is valid. In the visual communication aspect find out the percentage as 92.07%, it can be interpreted that the media is valid. The average value over all is 90.63%. It can be shown that the learning media has valid value in eligibility level then it can be used to learning media well.

The media expert stated that interested design aspect from color's composition between background and text is less contras. Then, the font size is less, it makes the text difficult to read, the icon pictures is not eye catching, and the combination of animation and material is not appropriate. While, the other media validation aspect is quite complete and clear. Therefore, there is suggestion to revise in material page especially SDLC V model. The suggestion is to add the audio which contains an animated image description, the competency test page that contains user name input is removed, and additional motivation displays.

The result of material expert validation finds out percentage as 97.7% in learning design aspect. It can be interpreted that the media is valid. In the visual communication aspect find out the percentage as 100%, and it means that the media is valid. The average value over all is 98.08%. It shown that the material in learning media has valid value in eligibility level. Therefore, the learning media is eligible to implement in students without revision.

The result of preliminary testing find out: 1) On the *usability* aspect obtained 90.18%, then it can be interpreted as a valid; 2) On the documentation program in learning media obtained 80.36%, then it can be interpreted as a valid; 3) On the providing learning motivation aspect obtained 82.14%, then it can be interpreted as a valid; 4) On the user friendly aspect and appropriate design aspect obtained 85.71%, then it can be interpreted as a valid; 5) On the clarity of material, video, and evaluation aspect obtained 82.14%, then it can be interpreted as valid; 6) On the communicative aspect obtained 85.71%, it can be interpreted as quite valid; 7) On the audio aspect obtained 86.61%, it can be interpreted as valid; 8) On the visual aspect obtained 84.52%, then it can be interpreted as valid; 9) On the moving media aspect obtained 85.71%, it can be interpreted as valid; 10) The last, on the *interactive layout* aspect obtained 87.05%, it can be interpreted as valid.

The average value over all in the preliminary testing is 85.46%. It shown that the learning media of software engineering process model (SDLC) subject is eligible to implement in the class without revision.

The result of field testing find out: 1) On the *useability* aspect obtained 92.89%, then it can be interpreted as valid; 2) On the documentation program in learning media obtained 84,80%, then it can be interpreted as a valid; 3) On the providing learning motivation aspect obtained 80,39%, then it can be interpreted as a valid; 4) On the user friendly aspect and appropriate design aspect obtained 82,35%, then it can be interpreted as a valid; 5) On the clarity of material, video, and evaluation aspect obtained 82,84%, then it can be interpreted as valid; 6) On the communicative aspect obtained 85.71%, it can be interpreted as quite valid; 7) On the audio aspect obtained 85,29%, it can be interpreted as valid; 8) On the visual aspect obtained 77,94%, then it can be interpreted as valid; 9) On the moving media aspect obtained 88,73%, it can be interpreted as valid; 10) The last, on the *interactive layout* aspect obtained 86,27%, it can be interpreted as valid.

The average value over all in the field testing is 84.56%. It shown that the learning media of software engineering process model (SDLC) subject is eligible to implement in the class without revision.

The result of real field testing find out: 1) On the *useability* aspect obtained 90,18%, then it can be interpreted as valid; 2) On the documentation program in learning media obtained 88,10%, then it can be interpreted as a valid; 3) On the providing learning motivation aspect obtained 81,25%, then it can be interpreted as a valid; 4) On the user friendly aspect and appropriate design aspect obtained 83,04%, then it can be interpreted as a valid; 5) On the clarity of material, video, and evaluation aspect obtained 84,23%, then it can be interpreted as valid; 6) On the communicative aspect obtained 85.71%, it can be interpreted as quite valid; 7) On the audio aspect obtained 85,86%, it can be interpreted as valid; 8) On the visual aspect obtained 86,61% then it can be interpreted as valid; 9) On the moving media aspect obtained 84,23%, it can be interpreted as valid; 10) The last, on the *interactive layout* aspect obtained 89,29%, it can be interpreted as valid.

The average value over all in the field testing is 846.27%. It shown that the learning media of software engineering process model (SDLC) subject is eligible to implement in the class without revision. Besides that, there is a suggestion from user to make all material in software engineering as learning media such as researcher proposed. They think that it will make students easily to learn another material in this subject, not only SDLC.

Based on the data obtained provide the final data such as 90.63 % from media expert, 98.08% from material expert, 85.46% from the preliminary testing, 84.56% from the field testing, and 86.27% from the real field testing. The average data obtained 89% and shown by Fig. 3.

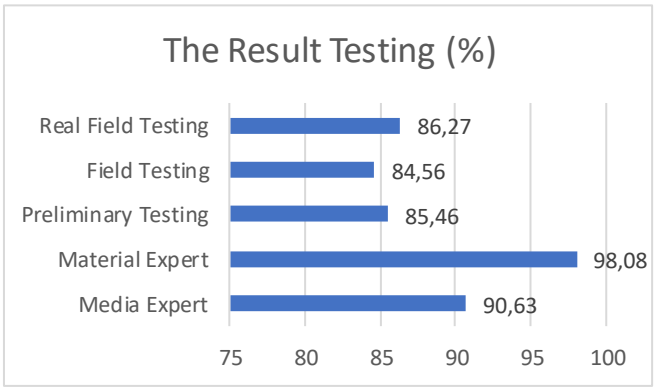

Fig. 3. Diagram of Learning Media Validation

Based on the graphic shown, the learning media proposed over all is valid without any revision with average value as 89 %. Based on the suggestion given by user, this

media still has improvement in software aspect, learning media design, and visual communication through improvement in any develop. The conclusion of improvement carried out by user to make an eligible media, such as: 1) learning media design is less interesting in terms of features, typographic, and color balance; 2) The function of button application is not appropriate; 3) The material arrangement is not suitable; 4) There are some features that are not suitable and must be removed; 5) The evaluation display completed by the right answer; 6) The evaluation score still show up when user won't continue the evaluation.

IV. CONCLUSION

The product obtained in this research and development is multimedia application for software development process model (SDLC) base *flash*. The learning media used as interactive and attractive multimedia application that can used to teach for lecturer or individual media learning for students.

This multimedia application operated by *offline* in the *windows* 7 operating system use animative buttons and appropriate *background*. In other side, this learning media completed by evaluation system that used to find out the students' understanding of the material.

The data analysis obtained 90.63% from media expert, 98.08% from material expert, 85.46% from preliminary testing, 84.56% from field testing, and 86.27% from the real field testing. Based on the analysis result determined the average value as 89%. It can be concluded that multimedia application proposed is eligible to use for lecturers and students as an individual learning media, especially for software engineering process model (SDLC) subject.

For the future works, this media needs to develop into smartphone (based on Android system), because nowadays, smartphone is very popular in society. This will make it easier for students to learn the material.

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