Developing E-Learning-Based Collaborative Learning Models to Improve Learning Outcomes of Multimedia Technology Courses

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Abstract. This study aims to develop an E-Learning-Based Collaborative Learning Model for multimedia technology courses. The development model used in this study was the ADDIE model. The study results are expected to help and facilitate lecturers and students to carry out a better learning process and increase mastery of Multimedia material. Based on the results obtained from expert testing and effectiveness testing, the development of collaborative learning media based on E-Learning multimedia technology was "Very Valid" and "Effective." E-learning multimedia technology courses improved student learning outcomes and were effectively used in the multimedia technology learning process. Collaboration between students and lecturers and students and students in utilizing e-learning provided a good relationship to increase collaboration during the learning process. E-learning also makes it easy for students to coordinate with other students or their study groups.

Keywords: e-Learning, Collaborative, ADDIE

1 Introduction

The education disruption is happening now. The COVID-19 pandemic affects education significantly, especially teaching and learning activities [1]. The earlier teaching and learning process characterized by face-to-face activity between educators and students have to change its model into online learning activities. This change needs much preparation. The demands of industrial revolution 4.0 also need an immediate and appropriate response by educational institutions. They must prepare reliable and competent humans through collaborative and creative learning models [2].

The collaborative learning model is intended to set students aside from passive attitudes and dependence on educators who hold the authority of learning materials. Collaborative learning is defined as a learning activity that provides students with a vast opportunity to be active during the learning process [2]. Educators have more roles and responsibilities as members during the process of seeking knowledge by students. The Collaborative Learning Model maximizes the

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cooperative process that takes place naturally among students [2]. Creating a learning environment that is student-centered, contextual, integrated, and has a cooperative atmosphere. Providing opportunities for students to be active participants in the learning process. Innovative learning is one solution that can be applied to Multimedia Technology courses. Multimedia technology is part of computer science that studies text, images, graphics, image compression, audio, audio compression, video, video compression, 2-dimensional animation, 3-dimensional animation, and the application of Multimedia software practicum. The very dense scope of knowledge in this course makes it difficult for students to understand the material during lectures. The density of the material seen in the syllabus and the time of practicum activities used in the lecture process for 3 hours of learning is not enough. The learning process for this Multimedia course will be greatly assisted by an innovative learning process that is able to explore students' creative and critical thinking skills as well as improve problem solving abilities and skills to participate in groups.

The E-Learning-Based Collaborative Learning Model development is expected to help and facilitate lecturers and students to experience a better learning process and improve mastery of Multimedia material[3]. Face-to-face learning activities will no longer bog down students and lecturers. The availability of e-learning content for Multimedia courses allows students to continue their collaborative learning process as it was done in the classroom.

This research is expected to prompt further research utilizing learning media in higher education. In academic circumstances, learning models other than innovative learning models can be tested using information technology, especially web-based technology. The collaboration between media and learning models can be developed further by moving the learning process in the classroom into online media, so that it will not be limited by time and place. In addition, the results of this study provide a theoretical basis regarding the importance of using learning media in the lecture process. The implementation of the development will inspire practitioners of learning media makers in particular and practitioners in education in general. This is related to the importance of accommodating the diversity of learners in learning, through a medium that can bridge learners to communicate in elaborating knowledge according to their respective abilities.

2 Method

The development model used in this study was the ADDIE model. This model was chosen because the ADDIE model is often used to describe a systematic approach to instructional development. The ADDIE model is a general learning model suitable for research and development[4]. The ADDIE model is sequential mean that the results of the evaluation of each stage can be used as the starting point of learning development for the previous stage. The ADDIE model can be seen in **Figure 1**. The development model consists of five stages, namely analysis, design, development, implementation, and evaluation [4], [5], [6].

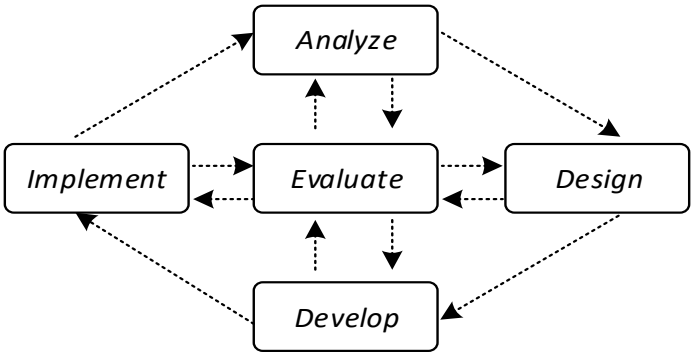

Fig. 1. ADDIE model development stages.

The Analyze stage was the first stage of the ADDIE learning system design model. The analytical activities carried out were the analysis of courses that included analyzing syllabus, determining competencies, analyzing the learning material and learning resources, and analyzing the characteristics of students. The students' characteristic Analysis result showed that students' interest in learning Multimedia Technology is 86%, with learning carried out in attractive media, such as images and videos.

The design stage was the second stage in the ADDIE development model. The design stage was carried out based on the results of the analysis stage. It was used as a reference in learning media development in the form of e-learning. In this stage, improvements were made if a design discrepancy between the needs of the user and the developer was found. Several activities were done at this stage, namely e-learning development design and Semester Learning Plan (RPS) design.

The development stage focused on developing the design obtained from the design stage into e-learning learning media content. This stage included compiling teaching and learning materials, creating video tutorials, and preparing evaluation instruments. Researchers also developed a questionnaire to measure the suitability of teaching materials and questions along with their answers that would be used in learning activities. The development of e-learning was carried out by applying the design made by representing it into the Moodle media, which is already available on the single sign on the system of Universitas Pendidikan Ganesha.

At the implementation stage, the developed learning media was tested. The test was aimed to ensure the feasibility of the developed product. The test consisted of the content expert test, design expert test, individual test, small group test, and field test. The researcher used a questionnaire as an instrument for the assessment during the test.

The evaluation stage was carried out by evaluating the data obtained from trial activities. In this study, the type of evaluation used was a formative evaluation. This evaluation was carried out to collect data from each stage of development. The data gathered was then used as the basis for improvement. The formative evaluation was selected because the present research was a kind of research and development to improve the existing product [7]. The formative evaluation was carried out in phases, namely: the expert evaluation phase, the individual evaluation phase, the small group evaluation phase, and the field evaluation phase.

3 Result and discussion

The results of the present research were an e-learning based collaborative learning model to improve learning outcomes of multimedia technology courses using research and development (Research and Development) methods with the ADDIE model. The model consists of five stages, namely Analyze, Design, Development, Implementation, and Evaluation. The results of each stage using the ADDIE model will be explained as follows.

3.1 Analysis stage

The analysis results on the Multimedia Technology course showed that several lecture objectives must be achieved by students in lecture activities. Those objectives include discussing text, images, graphics, image compression, audio, audio compression, video, video compression, 2-dimensional animation, and Multimedia support software. Based on the results of the questionnaire distributed to students, data were obtained that students' interest in Multimedia Technology lectures was 88%, the learning delivered in attractive media, for example in the form of images or videos. The analysis of learning outcomes for multimedia technology courses showed 55%, fairly low compared to the expected achievement of 80%. This was because all students do not have hardware supporting tools as supporting multimedia software. The learning process has been carried out fully online. The solution offered is to develop a collaborative learning model by utilizing E-learning to improve learning outcomes.

3.2 Design stage

The design stage focused on arranging menu structure in e-learning. Undiksha's e-learning uses the Learning Management Systems (LMS) platform, namely Moodle. The Undiksha e-learning requires the user to be registered as an active student or lecturer, then the login process uses the single sign on (SSO) system. The menu structure in e-learning consists of two main menus, including the Home and Course menus. When opening e-learning schoology, users are asked to log in on the login page. When the user has logged in, the user will then be redirected to the Home page. Several menus will be displayed on this page, including courses overview, groups, grades, search, navigation, notification, and online user.

The E-learning design developed requires students to do a checklist (manually or automatically by the system) to ensure that students read or follow every content on each stage of learning of the e-Learning. Students are also required to access every activity in text materials, videos, interactive quizzes, forums, and other activities available on Undiksha e-learning, especially multimedia technology courses. The design was developed to accommodate a collaborative learning model into every stage of the online lecture process. This online collaborative learning model emphasizes that each individual or student works together in study groups to build knowledge, instill attitudes, and perfect skills.

3.3 Development stage

The development stage included the development of multimedia technology learning content that would be incorporated into e-learning. Developing teaching materials was done by collecting materials, writing the materials, compiling materials, and evaluating instruments following the expected learning objectives. The first stage of development activity began with collecting teaching materials and writing teaching materials. The second stage was the preparation of learning materials in the form of (1) Learning Modules, (2) Learning Videos, (3)

Practical Video Tutorials, (4) Summary of Learning Materials, and (5) Evaluation Instruments which were then written into e-learning for multimedia technology courses.

After calculating and reviewing the test results gathered from learning content experts, it could be stated that the e-learning was "Appropriate." The level of validity of the developed e-learning was calculated by the following formula.

$$\text{Content Validity} = \frac{23}{(0+0+0+23)} = 1.00$$

The results of the validity calculation were converted into the level of validity criteria. The results show that the level of validity with the largest coefficient of 1.00 is at the "Very High" level with the criteria of "Very Valid." This shows that the content of the e-learning was valid or suitable for usage in Multimedia Technology classes.

After calculating and reviewing the test results gathered from learning design experts, it could be stated that the e-learning was "Appropriate." The level of validity of the developed e-learning was calculated by the following formula.

$$\text{Design Validity} = \frac{12}{(0+0+0+12)} = 1.00$$

The results of the validity calculation were converted into the level of validity criteria. The results show that the level of validity with the largest coefficient of 1.00 is at the level of "Very High" with the criteria of "Very Valid." This shows that the learning media in e-learning were valid or suitable for usage in Multimedia Technology classes.

After calculating and reviewing the test results gathered from learning media experts, it could be stated that the e-learning was "Appropriate." The level of validity of the developed e-learning was calculated by the following formula.

$$\text{Media Validity} = \frac{18}{(0+0+0+18)} = 1.00$$

The results of the validity calculation were converted into the level of validity criteria. The results show that the level of validity with the largest coefficient of 1.00 is at the level of "Very High" with the criteria of "Very Valid." This shows that the learning media in e-learning were valid or suitable for usage in Multimedia Technology classes.

3.4 Implementation stage

At the implementation stage, the results of e-learning that have been developed were tested following their roles and functions in learning activities in order to determine the extent of the benefits of the products that have been developed. After e-learning products were revised based

on input or reviews by experts, then e-learning was applied to individual trials. The subjects used in the individual trial were three students in Semester V, consisting of one student with high learning achievement, one student with moderate learning achievement, and one student with low learning achievement. This achievement was determined from the results of the pre-test. The test was initiated by providing general information about e-learning for Multimedia Technology courses, then students were assigned to access e-learning. In this individual trial activity, e-learning was tested by students as a whole, and each student who became a respondent was given an individual test questionnaire. Furthermore, a recapitulation of the results of individual trials was carried out to determine the level of achievement obtained from each respondent. The graph of the results of the recapitulation of individual trial results can be seen in the **Figure 2** below.

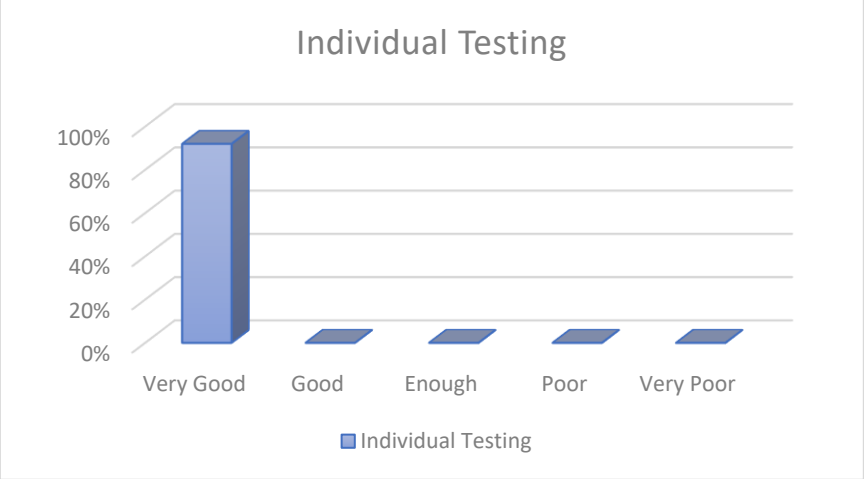

Fig. 2. Graph of recapitulation result of individual testing.

The results after being converted showed that the percentage of achievement levels per category was "Very Good" at 100%, "Good" at 0%, "Enough" at 0%, "Less" at 0%, and "Very Poor" at 0%. It shows that the development of the e-learning-based collaborative learning model for multimedia technology courses could be categorized as "Very Valid" and was feasible to be applied in real situations. The application of e-learning facilitated the learning processing term of reducing problems in acquiring learning resources because learning resources could be accessed anytime and anywhere.

Small groups test was conducted after individual trials. This small group trial subjects were ten students on the fifth semester classified into three levels, consisting of 5 students from high learning achievement, three students from medium learning achievement, and two students from low learning achievement. The selection of those ten students was based on the pre-test score. Before commencing the test, students were given a general explanation about e-learning being developed, and then students were assigned to access e-learning that will be used in learning.

After students tried all the learning activities, they were given an assessment instrument in the form of a questionnaire. The graph of the recapitulation of the small group trial assessment can be seen in **Figure 3**.

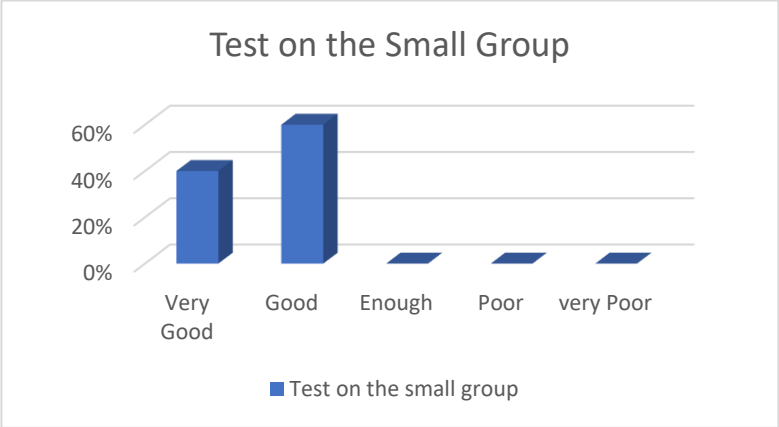

Fig. 3. Graph of recapitulation result of small group testing.

The results after being converted show that the percentage of achievement levels per category was that "Very Good" at 40%, "Good" at 60%, "Enough" at 0%, "Poor" at 0%, and "Very Poor" at 0%. This shows that the development of e-learning in the Multimedia Technology course was "Valid" and feasible to be applied as it was categorized "Very Good" and "Good." The application of e-learning simplified the learning process and increased collaboration between educators and students.

After testing the development of e-learning collaborative learning models, then field trials were carried out. In the field trial activity, researchers used 1 class that took Multimedia Technology lectures with 25 respondents. The number of respondents was classified based on different levels of achievement and knowledge, ranging from high, medium, to low. Field trials were conducted five times online, both asynchronously and synchronously. The learning process when field trials were carried out with stages in the Collaborative Learning Model. The graph of the recapitulation of the field trial assessment can be seen in **Figure 4**.

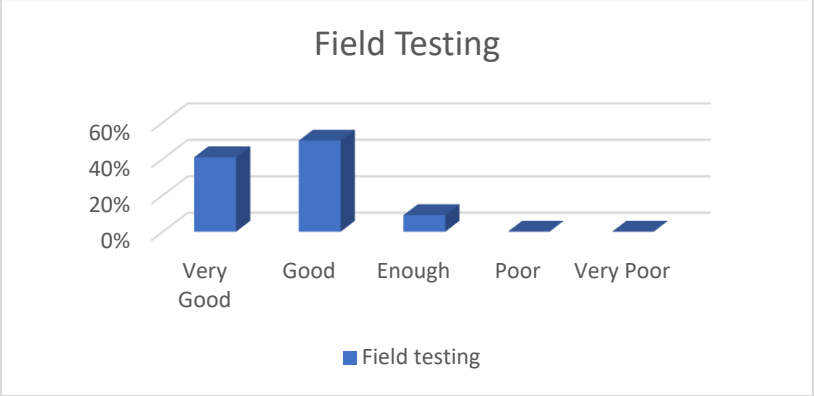

Fig. 4. Graph of recapitulation result of field testing.

The results after being converted show that the percentage of achievement levels per category was "Very Good" at 41%, "Good" at 50%, "Enough" at 9%, "Less" at 0%, and "Very Poor" at 0%. This shows that the development of e-learning for the Multimedia Technology course was categorized as "Valid" and was feasible to be applied, and the implementation of e-learning simplifies the learning process. Based on this result, it was found that collaboration between students and lecturers, as well as students and students in utilizing e-learning, provided a good relationship to increase collaboration during the lecture process. The use of e-learning also makes it easy for students to coordinate with other students or their study groups.

3.5 The result of evaluation stage

The evaluation of the development of the e-learning-based collaborative learning model for multimedia technology courses had been carried out in the revision of each testing phase. However, in addition to the evaluation carried out at the implementation stage of product testing, there were several other evaluations that the researchers carried out during the development of e-learning using the ADDIE model. The evaluation is a test of the effectiveness of the e-learning to achieve the expected goals. The effectiveness test of e-learning learning was carried out by giving pre-test and post-test to students who took multimedia technology courses.

Effectiveness test was done by giving pre-test and post-test aimed at determining the improvement of the learning outcomes after using e-learning media for multimedia technology courses. The results of the pre-test and post-test values were calculated to find the value of N-Gain or Normalize Gain. The average result of the pre-test score was 54, and the average post-test result was 94. The average improvement was calculated by subtracting the post-test average value from the pre-test average value. The value of the average improvement was 40. The N-Gain value of the level of improvement in the post-test results is stated below.

$$N - Gain = \frac{Posttest\ Score - Pretest\ Score}{Maximum\ Score - Pretest\ Score} \quad (1)$$

$$= \frac{94-54}{100-54} = \frac{40}{46} = 0{,}87$$

The graph for pre-test and post-test average can be seen in **Figure 5**.

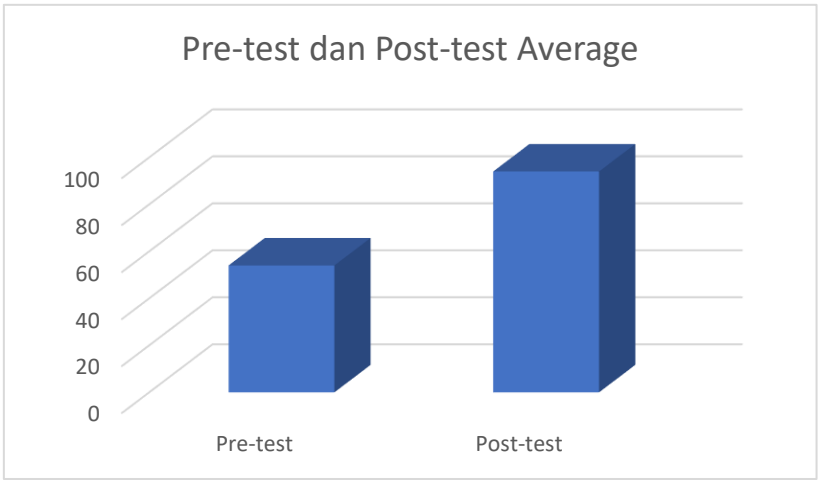

Fig. 5. Graph for pre-test and post-test average.

After determining the amount of value improvement, the calculation proceeded to acquire N-Gain or Normalized Gain. The result obtained from the N-Gain calculation was 0.87. The rate of improvement in post-test results was then categorized as "Effective" [8]. Based on the results obtained, e-learning on multimedia technology courses could improve student learning outcomes and be effective for usage in the multimedia technology learning process.

The development of the e-learning-based collaborative learning model for this multimedia technology course was expected to help and facilitate lecturers and students to carry out a better learning process and be able to increase the level of mastery of multimedia material. In practice, lecturers and students will not be focused on the face-to-face learning process [9]. The availability of e-learning content for Multimedia courses that can be accessed on various occasions will make it easier to continue learning in a collaborative process like what is done in class. Based on the results obtained from expert testing and effectiveness testing, the development of collaborative learning media based on E-Learning multimedia technology produced "Very Valid" and "Effective" [10]. Technology development, especially in learning media, is helpful for individuals who are in far-flung locations, allowing them to collaborate online. Collaborative learning needs media for communication. Communication in this term includes accessing information, asking questions, understanding the concept, formulating goals, repeating exercises, reflecting, discussing, debating, articulating, and documenting the ideas presented.

4 Conclusion

It can be concluded that the e-learning-based collaborative learning models to improve learning outcomes of multimedia technology courses have been successfully developed, categorized as "very valid" and "effective," seen from the results of expert testing and effectiveness testing. Cooperation between lecturers and students in utilizing e-learning provides a good relationship to increase collaboration between them. The use of e-learning facilitates for lecturers and students allows them to share information and interact either personally or in groups. The use of e-learning assists students in coordinating with other students or their study groups. It is easier for students to share information, communicate, and provide feedback on their activities. In addition, students can construct their learning outcomes. This collaborative activity can be applied to the online lecture process and can be carried out anytime and anywhere. However, e-learning-based collaborative learning model development products to improve learning outcomes of multimedia technology courses that have been developed have not yet reached the stage of learning outcomes assessment by students. Therefore, it is necessary to conduct further studies on the effectiveness of e-learning by assessing through experimental research using collaborative learning models or with other learning models.

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