Development of E-Learning Model to Improve Learning Outcomes

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Abstract: This research is motivated by the low of mechanical engineering learning result of the tenth grade SMK students. The problem of this study is that whether or not e-learning Model is effective to improve learning outcomes in the subjects of Mechanical engineering in SMK? The purpose of this study research is to produce E-learning Model which can improve students' learning outcomes on the subject of Mechanics Engineering in Building Engineering Skill Program of SMK. This research uses Research and Development (R and D) method. The steps of model development in this study are: field study, relevant document analysis, development study, and program validation. The population consists of three vocational schools in Bandung with the samples are all tenth grade students of Building Engineering Skills Program. The data obtained are analyzed using quantitative (normalized gain score) and qualitative analysis (downsizing, demonstration, and data verification). Based on preliminary study of learning outcomes of the tenth grade students of SMK in Bandung on the subjects of Mechanical Engineering is still low which is 32.3% of 356 students who have not reached KKM (minimum mastery learning score). Effort to improve the students' learning outcomes is by applying the E-learning Model. The results show that E-learning Model is effective to improve student learning outcomes in the subjects of Mechanical Engineering. The effectiveness is indicated by the increase of average gain index, SMK 5 Bandung gain index is 0, 50000, SMKN 6 Bandung gain index is 0.722426, and SMKN PUN Bandung gain index is 0.28120. The increase of the overall gain index is 0.751816. The phases of E-Learning Model developed are: 1) interactivity; 2) independence; 3) accessibility; 4) enrichment, and 5) evaluation. Implementation of E-learning Model in learning process includes a limited and broad test. The teachers and students' assumption on E-learning Model is that it is very effective to improve learning outcomes but it needs adequate supporting facilities of computers and Internet networks. It is concluded that E-learning Model is effective to improve learning outcomes of mechanical engineering of the tenth grade SMK Students. The implications are for the development of concepts, curriculum, and learning process in SMK. The recommendations are addressed to principals, teachers, and subsequent research that can be taken into consideration in determining school policy, provision of facilities and instructional media, and subsequent research may take into account the limitations of this study.

1 INTRODUCTION

The learning result by vocational students on Mechanical Engineering subject as the sample of this study is still low. The result mentioned is the change in students' overall behavior and it is sedentary as the outcome of learning activities. Djamarah and Zain (2014, pp. 107) stated that learning outcomes are what students get after learning activities. This is evident from the achievement of students' learning outcomes during the odd semester which shows that about 50% of the 356 students are able to exceed the Minimum Mastery Criteria (KKM) and approximately 17.7% are able to reach the limits of KKM. So, the students unable yet to achieve KKM are of 32.3%. These learning outcomes are still far from expectations, especially in the subjects of Mechanical Engineering. This fact shows that there is something not optimal in the learning process.

The phenomenon of unable students to achieve KKM is the impact of less precisely model, method, and learning strategy applied. The method applied tends to be conventional learning model. The selection of leaning models and methods is a factor that leads to low learning outcomes. Teachers' inaccuracy in choosing the models, methods, and strategies applied in the learning process causes

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learning is not running effectively and efficiently in achieving goals. This is in line with the opinion of Developing Team of MKDP Curriculum and Learning (2011, pp. 141) who suggest that one of the factors affecting student learning outcomes is the school environment which in this case includes teacher competence in teaching and applied learning methods.

Methods application in the learning process is one of the keys to the success of student learning in school. The better and effective a method of learning is applied, the higher the achievement of student learning outcomes is. This is evidenced by several research results, such as Fatimah (2011), Setiawan (2013), and Sulistyo (2013) on the application of learning models and methods to improve learning outcomes and they turn to be effective. The effectiveness is shown by the improvement of student learning outcomes after the application of methods and learning models compared to before the implementation of the learning method. The three results of this study indicate that teachers' selection and application of models, methods and strategies of learning which are appropriate and relevant to the materials are determinants of students' learning outcomes achievement.

Students can achieve optimal learning outcomes by applying appropriate models, methods, and strategies which completely support their learning activities and provide technical clarity of the subject matter they are studying. One of the learning models considered to support the learning of the material is E-Learning model that, as explained by Cisco (in Rusman, 2014, p.347), philosophically: 1) delivers information, communication, education, and training via on line; 2) provides a set of tools that can enrich the value of learning conventionally (conventional learning model, study of textbooks, CD-ROM, and computer-based training) so as to respond to the challenges of the development of globalization; 3) does not mean replacing the conventional learning model in the classroom, but reinforces the learning model through content enrichment and the development of educational technology; And 4) harmonizes better alignment between the content and the conveyor with the learning style, so that the better students' capacity in turn give better results.

E-learning is one of learning forms implemented in digital format through internet technology in order to carry out student self-learning. This system can be used in distance conventional education. Therefore, the development of this model does not merely present the subject matter into the internet but it needs logical consideration and holds the principle of learning. Similarly, the development design is simple, personal, and fast, and the elements of entertainment make learners feel comfortable in front of the internet as they learn in the classroom.

E-learning has complex functions that can improve student learning outcomes optimally. According to Siahaan (2002), there are main functions of electronic learning of classroom instruction, namely: supplements, complement, and substitution. This can be achieved because e-learning model provides systematic, effective, and efficient learning system. Afaneh (2006, p. 13) asserts that the design of e-learning model is a systematic process whereby the designers of learning "…should follow in order to achieve the creation of efficient and effective instruction. Or more simply put, Instructional Design is a framework for learning".

The subject of Mechanical Engineering is included in productive subjects, which are required to produce products and services according to market demands. Mechanical Engineering is a science that applies the principles of engineering, physics, and science for mechanical system design, as proposed by Webster (2014). The scope of this Mechanics Engineering study requires an understanding of the basic concepts of mechanics, kinematics, thermodynamics, materials science, structural analysis, and electricity in the application of facilities such as computer equipment to make product lifecycle management.

Afaneh (2006, p.16) argues that e-learning is basically a product where "Quality e-learning takes a significant amount of time and thought to develop." Thus, it can be understood that the merger between User-Centered designs (e-learning user-focused design) with e-learning model design is ensured to be useful and meaningful to its users, in this case teachers and students. What exactly is a user-centered design? In this case, Evans (in Afaneh, 2006, p.16) explains that it is an experience-creation approach combined with the needs of one's thinking that provides the advantages of ease of use and easy to learn. This design puts users as active participants where user situations, such as learning, performing and producing something can be explained as the totality of experience with a product.

When all the steps of learning mechanical engineering by utilizing this E-learning design are already done, the last thing to be concerned about is the evaluation process. There are several reasons and advantages of this evaluation process, first and foremost is that evaluation is part of every form of instructional design, such as ADDIE (Analysis,

Design, Development, Implementation and Evaluation).

The main problem of this research is, "Does the E-learning Model effectively improve the learning outcomes in the subjects of Mechanical Engineering in Vocational High School?" and the main purpose of this research is to produce E-learning Model that can improve learning outcomes in the subjects of Mechanical Engineering in Vocational High School. This is the underlying need for a research and development related to E-learning model that can improve student learning outcomes on learning Mechanical Engineering.

2 RESEARCH METHOD

The approach of study is Research and Development (R and D) that is a process or step to develop new products or improve products that already exist which can be accounted for. The basic consideration of this approach is the opinion of Borg and Gall (1989) which state 'a process used to develop and validate educational product', that effective research and development strategies are for developing and validating educational products. Meanwhile, the method used in this research is Mixed Methods Design (Creswell, 2008, p.5) that combines or associates qualitative and quantitative forms.

The steps of research and development of E-learning model are: field study, relevant document analysis, development study, and program validation. These steps are the result of developing views of Borg and Gall (1989) and Sugiyono (2017). According to Borg and Gall (1989, pp. 783-795), the Research and Development (R and D) approach in education includes ten steps: 1) Preliminary Study; 2) Planning Research; 3) Design Development; 4) Preliminary Field Test; 5) Revision of Limited Field Test Results; 6) Main Field Test; 7) Revise of Wider Field Test Results; 8) Feasibility Test; 9) Final Result Revision of Feasibility Test; And 10) Dissemination and Implementation of the Final Product.

The subjects of research are class X of three vocational schools of expertise in Building Engineering Program in Bandung, with the total population of 356 people. The samples as source of data in this study are taken based on purposive sampling technique.

The data obtained from the samples are collected as materials for the effectiveness test of developed learning model. Data collection techniques used in this study are: 1) preliminary study; 2) observation; 3) documentation study; 4) interviews, and 5) test of learning results.

The obtained data are analyzed using two techniques, namely quantitative and qualitative. Quantitative analysis technique uses normalized gain score method. Qualitative analysis uses: data collection process, data reduction, data display, and data verification. Test of data validity is done through four forms of testing, namely credibility, transferability, dependability, and conformability, (Sugiyono, 2017).

3 RESULTS AND DISCUSSION

The results of preliminary study shows that, before the implementation of E-learning, there are still many Civil Engineering skills program vocational school students whose learning outcomes are not yet optimal at the beginning of Mechanical Engineering learning. At the beginning of learning the teacher first prepares the learning tools include: annual program, semester program, syllabus, lesson plan, worksheet, and evaluation tool. The selected learning model developed in RPP is a lecture method that is assisted by media of infocus (power point), blackboard (chart), examples of images, the use of props, and examples of construction around students as well.

Barriers to learning of the three SMKs used as research samples are: 1) students' ability to understand basic mathematics is very diverse, even most of them have low ability; 2) learning process does not apply appropriate learning strategy in accordance with basic competence demands to be mastered by students; 3) availability of facilities and instructional media for inadequate mechanical engineering in schools, and 4) non-optimal utilization of facilities and instructional media by teachers and students. These barriers hinder the achievement of optimal students' learning outcomes. Learning outcomes are forms of behavior change that exists in students' attitude. Djamarah and Zain (2014, pp. 107) explain that learning outcomes are what students get after learning activities. Both opinions imply that learning achievement is form of person's behavior after going through learning process.

Evidence of these barriers leads to the low learning outcomes based on preliminary studies. The result of preliminary study in the three SMKs which become the subject of the research is that the students in SMKN 6 Bandung City already reached the minimum mastery criteria as of 71.8%, the students in SMKN 5 Bandung reached 46.28%, and in SMK PU Bandung, the students reached 36.36%. So,

overall the learning process is not optimal, especially in the selection of learning models. As a matter of fact, there should be an effort to overcome these problems; one of them is by developing a model of learning. Learning model is an external aspect of students that influence learning outcomes. In general, there are two factors that affect the learning outcomes which are students' internal side and the environment. Carl (in Sudjana, 2006, p. 39) states that, "Student learning outcomes at school are 70% influenced by students' ability and 30% influenced by the environment". Learning model is an external aspect of student self that influences learning outcomes.

The effective and efficient learning model to overcome the problem is E-learning. Such effectiveness is supported by a more flexible learning model between teacher and student interaction, interaction pattern is more fun, easy, learning materials are easily accessible to students. The benefits of E-learning can be seen from two points of view, i.e. from the point of learners and teachers. From the point of learners, E-learning activities create the development of high learning flexibility. Brown (in Siahaan 2002) points out the benefits of E-learning learning model, namely: (1) learning process can be done in small schools in poor areas to follow certain subjects that his school can not provide, (2) learning process can be done in home to understand materials the parents can not teach, such as foreign languages and computer skills, (3) learners who drop out of school can continue their education, as well as learners residing in different regions or even abroad, and (4) learners who are not accommodated in conventional schools can also continue their education.

The benefits of applying E-learning model are not only obtained by students but also by teachers because it is easier to develop materials and broader student insights. Soekartawi (in Siahaan, 2002) explains some benefits that teachers get, namely: (1) more easily update materials that are responsible in accordance with the demands of scientific development, (2) developing oneself or conducting research to increase insight because there is more spare time to use, (3) controlling students' learning activities. Teachers can also know when learners learn, what topics are studied, how many times a topic is being studied, and how many times a particular topic is reviewed, (4) checking whether or not learners already do exercises after studying particular topics, and (5) Examining the learners' answers and notifying the results to them.

E-learning model aims to improve students' learning outcomes in Mechanical Engineering subject. This model is developed by utilizing Internet media for students' learning needs and the interaction between them and teachers are more open, especially in terms of study time which is not limited only to school hours. This model starts from planning process, the measurement of early ability of learners, the formulation of learning objectives, the determination of strategies or methods and approaches of learning, and the establishment of learning evaluation system; followed by the development of E-learning media, the application of learning models developed through the learning process in a limited trial, and ended up with an analysis of the results of its implementation in a limited trial process. The stages of E-learning model are: 1) interactivity; 2) independence; 3) accessibility; 4) enrichment, and 5) evaluation. Rusman (2013, p 292), based on the characteristics of E-learning itself, distinguishes E-learning model with conventional learning, namely: Interactivity (interactivity); more synchronous communication channels, such as chat or messenger, or asynchronous, Independency, Accessibility, and Enrichment are available.

Implementation of E-learning model developed in the subjects of Mechanical Engineering in SMK covers the limited and broad test. Implementation of limited test for E-learning model is to improve student learning outcomes implemented only in one vocational school. Before the learning process is implemented, pretest measurements are firstly taken, with an average of 36.08 outcomes from a maximum score of 110. The learning phases are implemented, including preliminary activities, core (exploration and elaboration), cover, evaluation of learning and analysis of learning outcomes on a limited scope. Based on the results of limited test analysis, it is concluded that there is a need be improved and developed. Improvement and development of E-learning model are done by arranging material feature structure and reinforcing and clarifying presented images. Newsletter of ODLQC (in Siahaan, 2002) explain that the terms of electronic learning activities (E-learning) include: Internet utilization, support of learning services, tutor services, managers, using computer wisely, reliable systems, evaluation systems, and mechanisms feedback.

Implementation of learning in pilot activities with a broad scope in the development of E-learning model aims to improve SMK student learning outcomes. Stages of learning carried out are same with limited trial process, only in terms of study subjects involving three state vocational schools in Bandung who have characteristics of different students' learning ability. Stages of activities undertaken in this second trial

include planning process that consists of curriculum assessment, implementation, and evaluation of learning. Extensive test results on the three SMKs that became the subject of research are as follows.

Table 1: Average increase in student learning outcomes.

No.	School	Pretest	Posttest	n-gain
1	SMKN 5 Bandung	36,08	73,04	0,5
2	SMKN 6 Bandung	84,09524	102,8095	0,722426
3	SMK PUN Bandung	35,32143	56,32143	0,281205
Total		**155,4967**	**232,1709**	**1,503631**
Average		**77,74834**	**116,0855**	**0,751816**

Source: Processed from the research data in annex 12,13, and 14.

Based on the above table 1, overall students' learning outcomes increase optimally. The increase is indicated by the overall average increase in student learning outcomes so the subject of research is the overall gain index which reached 0.751816. So, E-learning model developed is feasible enough to be applied to the learning process of Mechanical Engineering in SMK. This increase is supported by the benefits of applying an effective and efficient E-learning model. Kituyi and Tusubira (2013) argue that the application of E-learning systems requires efforts to reconsider its rules, revise its curriculum changes, and develop its services and learning methods. So, the development of learning methods needs to test its validity in order to prove its suitability in learning.

The validity test of research result and development of E-learning model in Mechanical Engineering subjects is done in four forms of measurement, namely credibility, dependability, conformability, and transferability (Sugiyono, 2017). The result of credibility test is done by triangulation of source, any information obtained from the source as the subject in this research is described and analyzed which is then checked by all member of the source. Dependability testing is done through an audit system of all evidence of research activities in the field. Conformability test aims to measure the objectivity of research conducted simultaneously with measurement dependability. Efforts to measure the level of transferability of E-learning model developed is conducted through a series of tests in conjunction with first-stage trials and second-stage trials by measuring and comparing the achievement of learning objectives of Mechanical Engineering achieved by students before and after the application E-learning learning model or using before-after experimental system. The application of the learning model in this study is based on the suitability, interest, and the three levels of implementation.

Teachers and students' assumption on the application of E-learning model developed is the variety of improvements in student learning outcomes influenced by various factors, both arising from the individual self of students and from the learning environment. These factors include motivation, communication, efficiency, and technology in the utilization of internet devices (internet devices) as a supporting medium of learning. This is in accordance with the views of the Newsletter of ODLQC (in Siahaan, 2001) and Sembel (2004). Description of the utilization of internet devices as one of the media information and communication of modern technology requires the availability of adequate facilities so that it can be used optimally.

4 CONCLUSIONS

The results of preliminary study shows that, before the implementation of E-learning, there are still many Civil Engineering skills program vocational school students whose learning outcomes are not yet optimal at the beginning of Mechanical Engineering learning. It is shown by the acquisition of students' evaluation score as much as 48.52% students of the three SMK who do not reached the minimum mastery criteria.

E-learning model developed to improve student learning outcomes of SMK in learning Mechanical Engineering is done by utilizing the internet media. This model starts from planning process, measurement of student's early ability, objective formulation, strategy setting, method, approach, and learning evaluation system. Learning stages of the E-learning model developed are: 1) interactivity; 2) independence; 3) accessibility; 4) enrichment, and 5) evaluation.

Implementation of E-learning model developed in the subjects of Mechanical Engineering in vocational school covers limited and broad test. The result of the limited test in one SMK is 36.08 from the maximum score of 110. The learning stages applied include the introduction, core (exploration and elaboration), closing, learning evaluation, and analysis. Improvement and development of E-learning model is by arranging material feature structure and reinforcing and clarifying the presented images. Extensive test results in three SMKs achieve an average score of 76.15 from a maximum score of 110. Totally, average increase in students' learning outcomes through the application of E-learning model is quite high; this is evident from the average size of the total gain index which reached 0.751816.

So, the E-learning model developed is feasible enough to be applied to the learning process of Mechanical Engineering in SMK.

The teachers and students' assumption on the application of E-learning model developed is the variety of improvements in student learning outcomes influenced by various factors, both arising from the individual self of students and from the learning environment. These factors include motivation, communication, efficiency, and technology in the utilization of internet devices (internet devices) as a supporting medium of learning.

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