Artikel 3

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Effectiveness of Constructivistic-Based Blended Learning Model Through Computer Numerical Control Courses

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ABSTRACT

This study examines the minimal number of credits and practical infrastructure in the CNC (Computer Numerical Control) course in the Department of Mechanical Engineering, Universitas Negeri Medan (UNIMED) which is a separate obstacle for students in improving competence of CNC course. An alternative and a solution in the form of constructivist-based blended learning model used in learning CNC course. The lack of literature studies on the use of constructivist-based blended learning models used in learning CNC course, so research is still needed on this problem. The purpose of this study was to determine the effectiveness of the constructivist-based blended learning model used in the learning process of the CNC machining course. The data collection process was carried out by using learning outcome tests. This type of research is a quasi-experimental study with a total sample of 56 students of the Mechanical Engineering Education Study Program of UNIMED on the engineering expertise competency of CNC course. The results of the data analysis raised 2 (two) themes that were discussed, namely: (1) constructivist-based blended learning model had an effect on learning outcomes of CNC Course in the Department of Mechanical Engineering Education, Unimed; and (2) constructivist-based blended learning model. The study of the two themes led to the conclusion that the two themes were effectively used in improving student learning outcomes in the CNC course at the Department of Mechanical Engineering Education, Unimed.

Keywords: Effectiveness; Learning Models; Blended Learning; CNC Course.

INTRODUCTION

The era of globalization occurs because it is triggered by the development of science and technology which is growing rapidly, especially in the field of information and communication technology (ICT). Developments in the field of ICT have not only led to globalization, but have also changed almost all human life. Various aspects of human life have been touched and have even changed as a result of the adoption of information and communication technology. Almost all aspects of human life can no longer escape from the influence of ICT, such as aspects of culture, politics, defense and security, the world of work, the economy, domestic work, and of course also the world of education. There are ten roles of ICT as a source of learning, namely: First, the Source of Knowledge, is to integrate all learning reference centers on earth. For example, someone can access library sites in universities in other countries in order to find the required references, can search for the best materials and obtain sample case studies via the internet [1].

For Universitas Negeri Medan (Unimed), the above conditions have actually been realized. This can be seen from the 2015-2019 Unimed strategic plan (Renstra) which gives serious attention to the use of information and communication technology (ICT) in an effort to improve the quality and relevance of graduates. Medan State University also fully supports information and communication technology-based learning, this is shown by various supporting tools and applications developed at Unimed. On the hardware side, Unimed consistently develops datacenter procurement to support learning and application support including blade servers, storage load balancers, environment monitoring systems, fire systems and network monitoring systems as well as network devices such as routers, switches and rack servers [2].

More specifically, the results of the initial observations made on lecturers in the UNIMED environment show the same thing. Judging from the aspect of the learning process carried out by the lecturers so far, all lecturers (100%) stated that they had and at the same time used the syllabus as a reference in carrying out lectures; as many as 90% of them stated that they had the teaching materials that they prepared in the form of handouts and PowerPoints; This is in line with the equipment they use in lectures, namely in the form of laptops and LCD projectors (83%); Likewise with the lecture approach they carry out, most of them (80%) state that they use an approach that combines a student center oriented approach with a teacher center oriented approach. Meanwhile, the lecture model they apply (90%) is fully face-to-face, and only 10% of them state it is a combination of face-to-face and online.

Cyber-based education system is known as e-learning [3]. Meanwhile, it is seen from the aspect of lecturers' readiness in using e-learning. Broadly speaking, it can also be said to be ready. This can be seen from as many as 93% of them already have computers connected to the internet, even as many as 87% of lecturers who have computers in the form of laptops. Likewise, when they are in the office, there is already a computer connected to the internet that they can use while in the office. Another good thing is that all lecturers (100%) state that they have used computers for lectures, although only 60% of them use the internet for lectures, and 80% use the internet to add learning resources. Seen from the aspect of lecturers' attitudes towards the use of e-learning, it appears that only 87% of lecturers realize that the internet is a very rich source of learning for lectures; in fact, only 60% agree that the internet is considered an effective medium for lectures. A little more (73%) of lecturers agree that the internet can be used as an efficient medium for lectures.

The CNC course is a course on a control system that uses a numerical system. This CNC system is used to control machines with mass product quantities, high accuracy, and high speed too [4]. This CNC course requires the knowledge and skills needed to achieve competency standards in the field of CNC Machining Engineering. The competency standards demanded by the CNC Machining Engineering course consist of several basic competencies, namely; (1) CNC Machine Programming, (2) Mastering CNC machine instructions (3) Setting up machines and editing CNC programs, and (4) Operating CNC machines. The general learning objective of the CNC Machining course is to require that students of the Mechanical Engineering Education study program after taking this series of courses will be able to master and use the CNC program to manufacture workpieces according to the set standards.

Based on the characteristics of learning competency in CNC machining techniques in SKKNI which includes theory and practice, it is seen that for the purposes of developing the competency learning, one type of learning model cannot be used. A model is defined as a form of accurate representation as an actual process that allows a person or group of people to try to act on the model [5]. The combination of several existing models to be developed into a new learning process design according to specific competency characteristics is needed. The combination of the currently implemented learning model, the complete learning model, the competency-based learning model, the computer-based learning model, and the experiential learning model can be developed an effective competency learning process for CNC machining techniques using the blended learning model.

The learning theory that underlies the development of the blended learning model and the competency learning of CNC machining techniques is a constructivist learning theory. Constructivist means constructive. Learning in the view of constructivism is "constructing" knowledge or in other words "building" knowledge. This means that knowledge is built from the process of integrating new knowledge into existing cognitive structures and adapting cognitive structures with new information obtained [6].

Competency learning of CNC machining techniques consists of learning theory and practice that are carried out simultaneously. Learning must enable students to learn actively at their respective speeds and accommodate learning by doing learning. Experiential learning model with learning cycles: concrete experience (feeling), reflective observation (watching), abstract conceptualization (thinking), and active experimentation (doing) [7].

The process of active learning and learning by doing can be implemented by using the blended learning model. The constructivist-based blended learning model strongly supports the active learning process of students to gain concrete experiences in accordance with constructivist learning theory. In essence, there are three basic stages in the blended learning model with reference to ICT-based learning [8]. The three basic stages are described as follows: (1) Seeking of information. The seeking of information stage covers the exploration of information from various sources of information stored online or offline based on relevance, validity, content reliability and academic clarity, providing input for students to seek effective and efficient information to become the role of educators or facilitators at the seeking stage this information; (2) Acquisition of information. At the acquisition of information stage, students both individually and in cooperative and collaborative groups try to find, understand, and confront them through ideas

and ideas contained in students' reasoning, interpret information from various available sources, until students can communicate. return and interpret ideas and interpretation results by using various facilities; (3) Synthesizing of knowledge. The synthesizing stage of knowledge is to build and improve the knowledge of students through a process of assimilation and accommodation that focuses on the effects of analysis, discussion and formulation of conclusions from the information received.

The five main keys in the blended learning process while practicing the learning theories are described as follows: (1) Live events are direct or face-to-face learning as synchronous at the same time and place or at the same time but the place is different; (2) Self-paced learning is a combination of independent learning which requires students to learn online anytime, anywhere; (3) Collaboration is a combination of collaboration, both collaboration between educators and students as well as collaboration between students only; (4) Assessment is a combination of online and offline assessment, both in the form of tests and non-tests; (5) Performance support materials are learning materials that have been designed in digital form, which can be accessed by students both offline and online [9]. In fact, blended learning is able to make it easier for students and educators to carry out the educational process and create students and educators to work together to achieve educational goals that are mutually beneficial to one another.

The objectives of blended learning are as follows: (1) To guide students to be better in the learning process that is suitable for learning styles and preferences in learning; (2) Provide opportunities for educators and students to learn independently, be useful, and develop growth; (3) Escalation of plasticity scheduling for students, by combining face-to-face learning and online learning perspectives; (4) Face-to-face classes allow students to have interactive experiences, while online learning provides students with multimedia content rich in unlimited knowledge, anywhere and anytime as long as students are connected to internet access; (5) Overcoming learning difficulties that require problem solving through the use of various learning methods [10].

There are three models in the development of blended learning which consist of: a web course model, a web centric course, and a web enhanced course. The three models in the development of blended learning are described as follows: (1) The Web Course Model is blended learning using the internet for educational purposes with students and educators entirely separate and not using face to face. Teaching materials, discussions, consultations, assignments, exercises, exams, and learning activities in the Model Web Course model are entirely delivered via the internet; (2) The Web Centric Course Model is a development of blended learning using the internet by combining distance learning and face-to-face learning. A number of materials are given via the internet, and a number of other materials are given face-to-face and function to complement one another. In this Web Centric Course Model, educators can convey instructions to students for learning course material via the web that they have made. Students are also given guidance to find other sources from similar sites. In face-to-face learning, students and educators discuss more about the material findings that have been studied via the internet. (3) The Web Enhanced Course Model is a development of blended learning that utilizes the Internet to improve the quality of learning carried out in the classroom. In this case, educators are required to be proficient in surfing the internet in order to find quality information, presenting material through the web that is of higher quality and preferred, guiding and communicating via the internet, and other necessary skills [11].

METHODS

The research method used in this research is a quantitative method, with an experimental approach. The experimental design used in this study was the pretest-posttest group design. The independent variable in this study is the constructivist-based blended learning model (X). The dependent variable in this study is the learning outcomes of CNC Machining Techniques (Y) [12].

The population in this study were all even semester students of the Department of Mechanical Engineering, Unimed, while the sample in this study was class A as the experimental class with a total of 29 students, while class B as the control class with 27 students. The sampling technique was carried out by means of simple random sampling, which is a random sampling technique. To obtain data on learning outcomes of CNC machining techniques, the appropriate data collection technique is to use test techniques.

The data analysis technique used in this research is quantitative analysis technique. Before the data analysis stage, the data analysis requirements test was carried out, namely the normality test and the homogeneity test. After the test requirements are met, the next step is to analyze the independent sample t-test mean difference. The average similarity test is used to determine whether or not there is a difference (similarity) in learning outcomes after being treated in both the experimental class and the control class.

The average difference test was carried out, so to test the effectiveness of using a constructivist-based blended learning model in improving learning outcomes of CNC machining techniques at Mechanical Engineering Education students of FT Unimed, can use the N-Gain formula [13]. The criteria used to declare the effectiveness of the constructivist-based blended learning model in improving the learning outcomes of CNC Machining techniques can use the following interpretive categories [14]:

Table 1. Category of Precentage

Percentage (%)	Interpretation
< 40	Ineffective
40 - 55	Less effective
56 - 75	Effective enough
> 76	Effective

RESULTS AND DISCUSSION

Pre-test is the initial ability that students have before being given treatment. Meanwhile, posttest is the final ability of students after being given treatment. The students' initial ability in the control class reached an average score of 28.22, while the final ability of students was 78.36. For more details, see Figure 1.

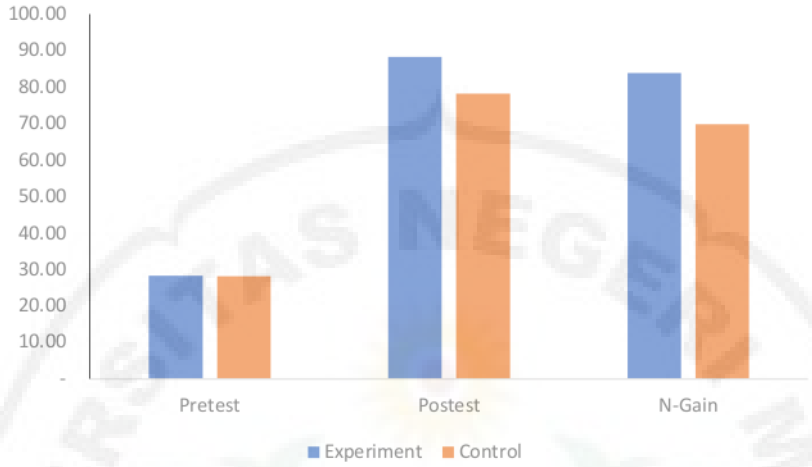

Figure 1. Diagram of the Average Pretest and Posttest Value in the Experiment Class and Control Class

The results obtained in table 1 show that the coefficient β_0 obtained is 62,533 with the coefficient β_1 is 0.269 the regression results obtained are:

$$Y = 62.533 + 0.269\ X$$

This shows that the relationship between the Initial Setting variable (X) and the science process skills variable (Y) is positive. Increasing the ability of students who are taught using the Initial Setting Figure 1 shows that the posttest score of student learning outcomes in the experimental class is higher than the control class. The posttest score of student learning outcomes in the experimental class was 88.38 while in the control class 78.36. The average N-Gain score for the experimental class was 84.00 with effective criteria, while the control class was 69.92 with sufficiently effective criteria. Based on these data it can be seen that from the two classes tested there was an increase in the average student learning outcomes in CNC Course. So, learning in the experimental class is more effective than learning in the control class.

Table 2. Summary of the Calculation Results of the N-Gain Score Test

Respondent	Experiment	Control
	N-Gain Score (%)	
Average	84.0069	69.9335
Minimal	75.32	62.96
Maximum	91.94	82.61

Based on the summary of the results of the calculation of the N-Gain score test in Table 2, it shows that the average N-Gain score for the experimental class is 84.0069 or 84.00%. based on the interpretation of the N-gain Score > 76% or by the "effective" category. Meanwhile, for the control class 69.9335 or 69.93% was included in the category between 56% - 75% "quite effective".

From the results of the above calculations, it can be concluded that the use of the constructivist-based blended learning model is effective in improving learning outcomes in the CNC machining engineering course in Mechanical Engineering Education Study Program students, Unimed. While the use of the usual learning methods that have been used in the category is quite effective to improve learning outcomes of CNC machining techniques for students of the Mechanical Engineering Education Study Program, Unimed.

Given the importance of model development in the learning process as described above, the development of a constructivist-based blended learning model carried out on the CNC Machining Engineering course is appropriate and can be used as a reference in developing constructivist-based blended learning models for other subjects.

The support system for the blended learning model is the elements that can help the implementation or what are the requirements and support needed outside the technical facilities of this model. Such as computer units, networks, student ability to access Learning Management Systems (Edmodo), lesson planning in the form of Semester Lesson Plans, modules, learning media, and evaluation sheets. The support system in developing this blended learning model is the availability of campus Learning Management Systems facilities that are equipped with e-learning services, lecturer resources who have the knowledge and skills to apply hardware and application software needed in implementing the learning model. Network and e-learning administrators who are ready to update and maintain e-learning web services, learning media in the form of hardcopy and softcopy modules, and students who have been equipped with the skills to use supporting devices when face-to-face in theoretical and practical classes.

The development of the blended learning model is also seen based on the principle of reaction, namely how the attitude of educators to students. This is almost the same as the social system, namely synchronization in carrying out their respective roles. If the social system explains the role of each educator and student, the principle of reaction governs how to carry out their respective roles. For example, when a lecturer greets when he enters the class, students will answer the greeting. In the blended learning model, when the lecturer explains certain material, students listen to it carefully; when students ask questions, the lecturer answers the questions. The principle of the blended model reaction is manifested in the form of lecture rules. For example, online lecture rules, face-to-face lecture rules, form of rules for students who complete assignments on time and those who are late, rules regarding agreements on online discussion and rules for how lecturers behave in taking each step in blended learning.

The social system of the blended learning model is a synchronization of interactions between lecturers and students. The interaction of lecturers and students is the core of learning activities that are important in every learning process. Interaction is an association between lecturers and students to achieve learning goals. The dimension of social interaction if it is associated with interactions in learning is the relationship between lecturers and students. The elements of social interaction are that the relationship between lecturers and students is work. Educators teach, guide and direct students while students learn, so that the learning process shows a social relationship between the two. Then, to achieve social interactions that occur in the learning process based on interests, especially the interests of students to learn and help students achieve competence after interacting with fellow students, lecturers, teaching materials and the learning

environment that occurs in the learning process. The social system in a learning model describes the roles of lecturers and students, relationships and types of recommended norms [15]. The role of lecturers in each model is different from one another.

The implementation of this model will combine face-to-face learning in the classroom (theory) and in the computer laboratory (practice) as well as online learning through e-learning services. Lecturers will prepare material in the form of modules in hardcopy form which are discussed face-to-face in class and laboratory and modules in softcopy form which can be accessed through e-learning services. The following are examples that can be used as references by students. Lecturers also provide chat services and online discussions for students at the agreed time. At the end of the lecture, the lecturer provides an evaluation in the form of a presentation project made personally and in groups to determine the success of the model in achieving learning objectives. The implementation of this model is planned for 2 meetings.

This blended learning model is expected to be able to overcome learning problems that are limited by face-to-face time in class and limited practicum facilities on campus. This model can also help students study independently both in theory and practice, students can carry out the learning process without depending on lecture time, they can access teaching materials and consult with lecturers anytime and anywhere with the help of internet access through campus e-learning services. This model can also hone students' skills in using ICT tools that indirectly help achieve learning goals.

CONCLUSION

Based on the results of the research and discussion, it can be concluded that: (1) the constructivist-based blended learning model has an effect on the learning outcomes of CNC machining techniques course; and (2) the constructivist-based blended learning model is effective in improving the learning outcomes of CNC machining techniques course.

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