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INCREASING COMPETENCY ON TIMBER ENGINEERING USING PROJECT - BASED LEARNING

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Abstract

Timber engineering course was previously carried out in a theoretical classroom and teacher-centred. Therefore, the students could not achieve the learning mastery indicator. Project-based learning model was implemented to solve that problem. This study was aimed to figure out how the project-based learning model (PjBL) was able to explain the occurrence of increased student competence in the Timber Engineering course. The study employed Class Action Research by Kemmis and McTaggart which consisted of four stages: (1) action planning, (2) action implementation, (3) observation, 4) reflection. The four stages formed a cycle and this study was carried out in the cycle until the fulfilment of learning mastery indicators. The study was conducted in two cycles because the learning mastery indicator was fulfilled in the second cycle. The results of the research in cycle I showed that students who scored more than 70 were only 33% and 67% of them scored less than or equal to 70. In the first cycle, the level of achievement of learning mastery indicators has not been met. This result became reflection for second cycle implementation. Furthermore, the implementation of cycle II showed that students who score more than 70 were 92% and only 8% of them achieved less than or equal to 70. This showed the level of achievement of learning mastery indicators has been met. Overall there has been an increase in the value of students who met the learning mastery indicator. The students who scored more than 70 from cycle I was 33%. This percentage increased in the second cycle to 92%. This result entailed that the project based learning model (PjBL) on Timber Engineering course could explain the increase of value that fulfilled the learning mastery indicator.

Keywords: Timber engineering, Competence, Project-based learning (PjBL).

1. Introduction

Construction Engineering Education program now implements the curriculum 2015 which is based on the Framework of Indonesian National Competence (KKNI). The Framework of Indonesian National Competence Based-Curriculum is expected to drive Construction Engineering Education program to produce graduates who are able to develop the field of construction engineering techniques through research and community service, and to create products in forms of learning facility for construction engineering. The curriculum of Construction Engineering Education program in addition to containing compulsory subjects also includes the selected subjects distributed in 4 specialization programs, namely: Construction Engineering Drawing program, Construction Engineering, Timber Engineering and Survey and Mapping. Timber Engineering Course is a part of the courses of specialization offered to undergraduate students of Construction Engineering Education program. Timber engineering course provides knowledge relating to basic furniture techniques includes knowledge of wood materials, preservation of wood and timber equipment in furniture.

Based on the reflection of learning, explaining the materials requires an inspiring and motivating atmosphere for the students during the lecture activities. Students should be more involved in teaching and learning activities direct learning experience, students should be given more opportunities to explore their ability and to demonstrate their ability optimally. Based on the results of these reflections, the teaching team of timber engineering implemented a learning model that involved the students' active participation and improved the processes ability expected to improve learning outcomes. Learning model which was applied in this study was a project-based learning model. The project-based learning approach enables the interaction between students and students with the environment. It is expected that there would be competitive nuance among students in groups. As a consequence, students can learn from each other and it is expected that it can grow motivation to learn.

Project-based learning is a learning method which using the problem as a first step in the collection and integration of new knowledge based on his experience in an actual activity. Project-based learning requires a comprehensive approach to teaching in which students' learning environment is designed so that students can conduct investigation on authentic issues and perform other meaningful tasks. This approach allows students to work independently in constructing his knowledge in real products [1]. Implementation of project-based learning strategy encourages the growth competencies such as creativity, independence, responsibility, self-esteem, and critical and analytical thinking. Project-based learning is supported by constructivist learning theory. Constructivism is a learning theory posits that learners construct their own knowledge within the context of his own experience.

Project-based learning can be seen as an approach which creates a learning environment that can encourage learners to construct their own knowledge and skills through direct experience. Projects in Project-based learning are built on learner's ideas as alternatives to real problem solving, and the learners experience the learning process of how to solve the problems directly. The Project-based

learning is based on real-world activity and it potentially expands and deepens the conceptual and procedural knowledge (Knowing That and Knowing How) [2]. Kerka [3] argues that Knowing 'That' and 'how' are not sufficient without the disposition to 'do'. Expansion and deepening the knowledge can be observed by measuring the increase in academic proficiency. The main role of the teacher is to control the ideas and interpretation of students during learning process, and provide alternatives through application, evidence, and arguments. Project-based learning has the great potential to provide a learning experience that is more attractive and meaningful for students.

The advantages of project-based learning are enhancing motivation, improving problem solving skills, improving collaboration, improving the skills to manage resources and increasing resource - management skills. Project evaluation is an assessment activity of a task that must be completed within a certain period. Assessment tool used is a check list, rating scale and product conformity with the specifications. There are three things to consider in project assessment:

a. Management ability

   Management ability is the ability of learners in choosing the topic and looking for information and in managing the time of data collection and report writing

b. Relevance

   Compliance with subject / skills by considering the stage of knowledge, skills and understanding in learning

c. Authenticity

   The projects undertaken must be the work of the learners by considering the contribution of teachers, industrial sector, guidance and support. Based on the description mentioned above, the problem in this study can be formulated as how the project-based learning can explain the increasing of students' competence in the timber engineering subject.

Competence plays an important role in the implementation of a task or a project. The term competence has been defined by various researchers in various literature. Competence is defined as integrated pieces of knowledge, skills and attitudes that can be used to carry out a professional task successfully [4]. Furthermore, Baartman and Brujin [4] argue that competence is an integration of skills, knowledge, and attitude. According to Azevedo et al. [5], competency is defined as a set of knowledge, skills, and behavior that must be gained, experienced, mastered and actualized by the teacher in performing professional duties. Hutapea and Thoha [6] categorize the competence into two groups, namely technical competence and behavioural competence. Technical competence only focuses on the knowledge and skills needed to do the job. This competence has not covered all of the basic components of competence. This competence is not an appropriate definition of competence. Because someone who has technical competence is only able to have knowledge and technical work skills. Technical skills only show the skills to perform a job and not include a person's ability to adapt to the work environment, accept challenges of work and behaviour productive.

Hutapea and Thoha [6] also define a behaviour as the behavioural competence, if the behavior described in the competence is the behaviour of

productive work (not the general behavior) and one can have and demonstrate the behaviour while performing the work, it can be concluded that the application of the behavioral competence includes the overall main component of competence.

Fuad and Ahmad argue that there are five characteristics of competence

a. The underlying character is defined as a person's personality that is quite deep and long lasting. The basic character leads to motive, personal characteristics, self-concept and values of a person
b. Criteria
c. The superior performance indicates the level of achievement of the highest ten percent of a work situation.
d. Effective performance is the minimum level of acceptable work results.

Swansburg and Swansburg [7] define competence as a state of being competent, characterized by suitability or adequacy of ability or fulfilling all demands, possessing capacity or capacity. Competence is a personal quality or the ability to perform the necessary tasks. Reece and Walker [8] defines competence as the ultimate goals, which is defined as "... goals that are to be Reached by the learner at the end of course in all of the subjects and all of the reasons ". While competence can be seen in the form of 1) communication skills, 2) problem solving skills, 3) self-appraisal and evaluation, and 4) as an effective working group member [8]. Muslich [9] also argues that competence is a skill that includes knowledge, skills and behaviour.

One of the problems found during the timber engineering subjects was that theoretical explanation of the subject was not supported by the concrete example from the field of furniture industry. This leads to less optimal learning. Therefore, the theoretical knowledge provided by the lecturers should be supplemented with a more concrete knowledge of furniture in the field.

Based on the problem above, the researchers argued that it was necessary to use a learning method that was able to provide a comprehensive learning experience for students to understand the furniture especially in timber engineering subject. One of the learning methods that was able to involve the participation of students and provide real experience in the field is a project-based learning method. The project-based learning method was employed in this study to bridge the gap of the experiential learning in furniture industry during timber engineering. This model was implemented by assigning tasks to the wood / furniture industry to obtain a concrete picture of timber engineering knowledge in the industry.

2. Method

The study was classroom action research using descriptive quantitative research design. The perspective used in selecting this type of study was to reveal the evidence which occurred during the study. 16 students taking the timber engineering course were involved in this study. Classroom Action Research which was used in this study based on Kemmis et al. [10] conducted in cycles. Each cycle consisted of: (1) action planning; (2) implementation of the action; (3) observation; and (4) reflection. The problems found during the learning process in Timber Engineering course were the basis for action planning. The action

planning was conducted to design the project which was given to the students during the timber engineering course. The next stage was the implementation of project-based learning. During the implementation of the action phase, the students were given a task to observe the furniture industry. The furniture industry observation was aimed to achieve the competence mastery of timber engineering concepts included: understanding the basic knowledge of wood materials in furniture; understanding the nature of wood cutting; understanding the properties of wood processing; understanding timber processing tools; timber veneer and timber lamination. Furthermore, the assessment of the assignment included reports and presentations.

During the presentation, the students were observed for their progress and their score was taken to determine whether the students have achieved the learning mastery score. The students were categorized as achieving the learning mastery, if their score was more than 70. The results of the students' presentation and report became reflection for the first phase. During the reflection phase, if most of the student achieved less than 70 for their presentation and report, then the results served as the basis to plan an action in the project-based learning on the second cycle. The cycle was stopped when most of the students achieved the learning mastery or obtain a score more than 70 for the presentation and report.

3. Data Analysis

Data analysis method used in this study was descriptive statistical analysis with quantitative approach. The initial condition of the timber engineering course related to the learning process and students' achievement of the learning mastery, the process of project-based learning implementation, and the condition after the project-based learning implementation were described in this study to figure out how effective the project based learning implementation in timber engineering course. The quantitative data in this study were students' score on their project presentation and report. The students were categorized as achieving the learning mastery, if their score was more than 70. The number of students who had achieved the learning mastery and who had not been expressed in percentage. The percentage of the students' score was then presented in the form of pie chart.

In this study, the competence was limited into achieving learning score more than 70 on the project presentation. If the students have achieved score more than 70 then the students were categorized as achieving the competence mastery in timber engineering subject.

4. Results and Discussion

4.1. The initial condition of timber engineering class

The timber engineering class was conducted in a more teacher-centred manner. The course was delivered theoretically only using teacher's lecture. The real-world example of how timber engineering is carried out in the industry was absent during lecture. Therefore, the students could not understand the concept of timber engineering. It resulted in the low achievement of the students in understanding the basic concept of timber Engineering.

4.2. The results of the study on the 1st cycle

The initial condition of the timber engineering course became the basis of planning an action to increase students' achievement in timber engineering course. The project-based learning was chosen to be implemented during the timber engineering course. The project-based learning could complement the absence of the timber engineering field knowledge on the theoretical class. As the students' project, the students were given a task to observe the furniture industry. The furniture industry observation was aimed to gain the field knowledge of timber engineering concepts included: understanding the basic knowledge of wood materials in furniture; understanding the nature of wood cutting; understanding the properties of wood processing; understanding timber processing tools; timber veneer and timber lamination.

The implementation of furniture industry observation took a month. The students were divided into a small group to observe different furniture industry. Each student then was given a task to present and report about their furniture industry observation individually to assess their individual knowledge. Their presentation and report about furniture industry were then assessed by the researcher as their scores. If the students have achieved score more than 70 then the students were categorized as achieving the competence mastery in timber engineering subject. The results on the first cycle showed that the overall score was still below the competence mastery. The students who obtained the score > 70 were only 33%, 67% of the students got the score ≤ 70 as shown in Fig. 1. The figure indicated that the level of competence mastery in timber engineering subject has not been fulfilled. This result became a reflection to continue for the second cycle implementation.

Figure 1 above shows that only 33% of the students achieving the competence mastery as indicated by score > 70. 67% of the students has not achieved the competence mastery as their score was lower than 70%. Based on this result, the cycle had to be continued on the second cycle of the study.

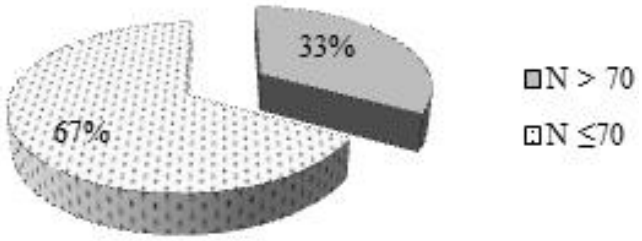

Fig. 1. Students' competence mastery on the 1st cycle.

The results of the students' presentation and report became the reflection and the basis of planning an action for the second cycle. The presentation and the report did not thoroughly capture timber engineering concepts such as: understanding the basic knowledge of wood materials in furniture; understanding the nature of wood cutting; understanding the properties of wood processing; understanding timber processing tools; timber veneer and timber lamination. Since the second cycle was aimed to improve the deficiency from the first cycle

to increase the number of the students achieving the competence mastery in timber engineering subject, before their second field industry survey, the students were asked to create an observation sheet, list of interview questions, and discussion with the workers to gain more thorough timber engineering concepts in the furniture industry.

The implementation of second furniture industry observation also took a month. The students then presented and reported the results of their furniture industry observation. Similar increase also occurred on the study of Harun et al. [11] stating that students' competence increased when they were engaged in an open discussion and project regarding the topic.

The results of this study on the second cycle can be seen on the Fig. 2 above. This figure shows an increase on the level of competence mastery. 92% of the students got the score > 70 and only 8% of the students who got the score ≤ 70. There was a significant improvement from the first cycle. On the first cycle only 33% of the students achieving score more than 70. Meanwhile, this number increased into 92% on the second cycle. The increase in the number of the students achieving score more 70 caused the cycle to stop.

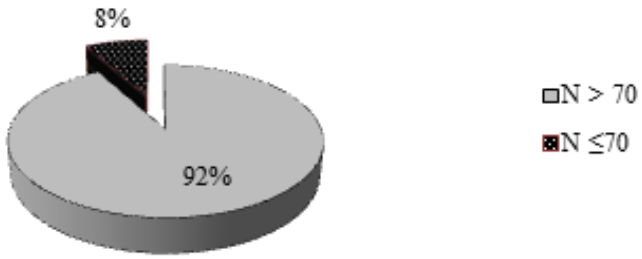

Fig. 2. Students' competence mastery on the 2nd cycle.

5. Discussion

The study has been conducted in two cycles. The 1st Cycle showed that most of the students did not achieve competence mastery. Therefore, the 2nd cycle was conducted based on the results of reflection on the first cycle. Improvement on the presentation of project report was implemented on the 2nd cycle especially on the optimisation of group work and communication activities. Approaches were made during the learning process. Some of the information which has not been maximally used through the activities going back to the field to obtain additional information and optimisation of group work for the preparation of the next presentation.

This project-based learning model required cooperative among group members. Therefore, the intercommunication between members could be more conducive, empathize, appreciative and could assist during the learning process. The cooperative condition was expected to grow students' interest in learning, induced more attention, confidence, relevance and satisfaction. Furthermore, an increase in interest in learning was expected to increase the level of competence mastery as shown in Fig. 3.

The learning process of project-based learning began with the inquiry by raising a guiding question to guide learners in a collaborative project that integrates a variety of subjects in the curriculum. At the time the question was answered, the learner could directly see the various main elements as well as the various principles in a subject being studied. The Project-based learning is an in-depth investigation on a topic of the real world. Given that each learner has a different learning style, project-based learning provides an opportunity for learners to explore content using various means that are meaningful to them, and conduct collaborative experiments. Project-based learning is an in-depth investigation of a real-world topic, a real-life experience on the ground. This finding is corroborated by Al-Atabi et al. [12] stating that the experiential learning can be provided by using project-based learning. In addition, the experiential learning at the industry could benefit the students for their future career Osman et al. [13].

Project-based learning can be said to be the operationalization of the concept of "Production-Based Education" in technical and vocational education. With production-based learning, learners are introduced to the atmosphere and meaning of real work in the occupational world. Through this learning model, a more positive attitude toward the students can be formed, because the learning situation is more conducive and fun.

The increasing percentage of the students who got the score > 70 showed that project-based learning was suitable to be implemented during timber engineering subject. On the 1st cycle, the students got the score of > 70 was 33%. This figure increased to 92% in 2nd cycle II and it has fulfilled the indicator of learning mastery, as shown in Fig. 3.

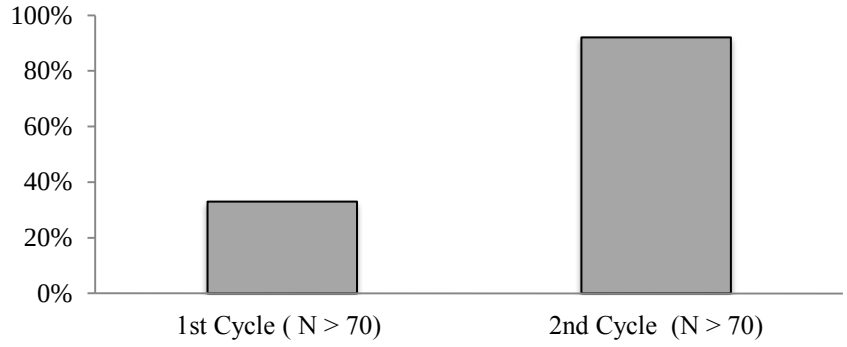

Fig. 3. Students' competence mastery on the 1st and 2nd cycle.

Figure 3 shows an increase of competence mastery with the criteria mastery score > 70. The competence mastery on the first cycle was 33%. This figure increased on the second cycle to 92%. The 8% of the student who did not achieve the competence mastery was the student who resigned from the lecture. Based on the results of this analysis, it indicates that the project-based learning method could improve the ability of academic and non-academic as the manifestation of the improvement of the competence is the integration of cognitive, affective and psychomotor ability.

It is also in accordance with the four pillars of education launched by UNESCO, namely learning to know, learning to do, learning to be and learning to life together. These four pillars provide consequences that learning should be based on the overall components of the pillar. The project-based learning method that is applied through two cycles in learning can explain the improvement of competence mastery.

The project-based learning method provides an opportunity for students to appreciate the ability to work together in the process and will further strengthen the relevance, self-confidence and satisfaction of the students. Increasing the interest of the students lead to the mastery of competence on the subject implemented in the tasks.

6. Conclusion

There was an increase in the comprehensiveness of competence mastery on the timber engineering. Therefore, the indicators of learning mastery have been fulfilled as explained through the implementation of 1st and 2nd cycle. The number of the students achieving > 70 on the 1st cycle was 33%. This figure increased on 2nd cycle to 92%.

The project-based model can be implemented in timber engineering, or similar subject which has similar learning structures / characteristics. Lecturers should emphasize more on self-strengthening and enrichment of students in a comprehensive manner. As a consequence, students' activities and competencies can be achieved optimally.

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