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Implementation of Troubleshooting Teaching Method to Develop Student's Competency in Conducting Motorcycle Tune-up

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Abstract. Lack of media used in teaching and the conventional method used are also become the factors which influence the less student's competency achieved in practical learning of motorcycle tune-up. This study aims to develop the student's competency in motorcycle tune-up by applying the Troubleshooting teaching method towards undergraduate students in Education of Mechanical Engineering department. This study used Classrom Action Research (CAR) which used 26 students as subject. They are Undergraduate Student in department of Education of Automotive Mechanical Engineering, Unesa, Indonesia. This study used test method to evaluate the student's competency in motorcycle engine tune-up. Based on the achieved data, it is then analyzed descriptively. This troubleshooting teaching method was able to develop student's study result (student's competency), started from 81,6 in cycle 1, then 83,3 in cycle 2, and 87,1 in cycle III. The completeness of classical study started from 53,8% in cycle 1, grew to 57,5% in cycle II, then reached 88,5% in the last cycle.

1. Introduction

The Motorcycle Practice Course is an important subject in the curriculum of undergraduate program in mechanical engineering education at the State University of Surabaya (Unesa). The purpose of this course is to give student the ability to perform engine tune-up and overhaul the motorcycle in line with preparing students to become candidates for teacher in vocational high school (VHS) or worker in automotive industry. Tune-up is the work or competence that must be mastered by automotive technicians who concerned with checking and adjusting the vehicle in order to restore the engine's performance to its original condition [1]. So this course is actually important and has a big role, but in fact the practice of motorcycle learning today still has problems.

From the results of the final semester of 51 undergraduate students' motorcycle practice courses, there were only one person who obtained the maximum score (A), two people obtained a D score, and others obtained B score. When presented in the table, the student's score distribution who attended motorcycle practice courses could be shown below [2].

Table 1. Data on Number of Students by Category Scores Obtained

Score Category	Score of Learning Result	
	Number of student (51 students)	Percentage (%)
A = 80 – 100	1	1,96%
B = 66 – 79	48	94,12%
C = 56 – 65	-	-
D = 40 – 55	2	3,92%
E = 0 – 39	-	-

Source: Unesa Mechanical Engineering Department (2015)

From the table above, it can be seen that the mastery of the material on motorcycle practice subjects has not been fulfilled because mostly students only get B scores, even though motorcycle competency mastery should achieve maximum competence, which is A. This standard is a necessity because of the strict demands of the industrial world which require full mastery of the competence.

The same condition happened to the results of industrial work practices carried out by students. It is shown by a lot of supervisors from their automotive workshop they work, deliver complaints towards student's performance. They complained that averagely student still lack of skill as indicated by the attitude of students who are still not confident to carry out the instructed practice. This hesitation caused many students to experience errors in handling tune-up cases in workshop and not all of them could be solved by students effectively which means they still took a long time to complete some work. As a result, students were only given a low work and tend to be only helper mechanics, which results in the target of work practice not being achieved.

Conventional learning methods that have been applied to the practice course of motorcycles do contain many weaknesses, including: 1) the learning steps that have not been systematic in accordance with the syntax of the applied learning method, 2) the demonstration of a competency taught is not easy to understood by student, 3) lack of further practices, 4) there is no study case learning in tune-up method which is actually benefit to improve competency mastery, and 5) the unavailability of instructional materials in the form of Student Worksheets and Learning Modules which used to be guidance for students when practicing.

In this study, efforts to improve the process and learning outcomes of motorcycle practice courses focused on the application of innovative learning with learning modules. Emphasis on the application of innovative learning is based on the main reason that the implementation of innovative learning is the most considered urgent compared to other efforts. This study applied the trouble shooting method that refers to the problem based learning approach (Problem Based Instruction). According to research conducted by Yuliati, Fauziah, and Hidayat (2018), it turns out that the application of problem solving learning can improve critical thinking skills among students [3]. Furthermore, the study conducted by Wahyu, Kurnia, and Syaadah (2018) with the application of problem solving learning turned out to be able to increase student learning motivation [4]. Ali, Hukamdad, Akhter, and Khan (2010) through the results of their research recommending that teachers should encourage students to be able to improve problem-solving skills in the learning process especially mathematical concepts [5].

In this troubleshooting method, students are presented with study cases which are the common problem on motorcycles, then students will learn how to diagnose based on existing symptoms and finally attempt to fix the damage. By this kind of learning, it is expected that their motivation will increase because students are faced with challenges in the solving the cases, then they will learn a lot about various cases that will enrich their experience so that finally their practical competence expected to be developed.

2. Research Method

This research is action research, due to the purpose is to solve the problem of learning process in classroom. This research also includes descriptive research which describes how a learning technique is applied and how the desired results can be achieved [6], [7]. The research design used refers to the research model of Kemmis and Taggart. Mentioned in that study that the design used was spiral from one cycle to the next, where each cycle includes plan, action, observation, and reflection. The steps in the next cycle are revised plans, actions, observations, and reflections. Before entering the first cycle, preliminary actions applied by problem identification. The spiral cycle of the stages of classroom action research can be seen in the following figure [8].
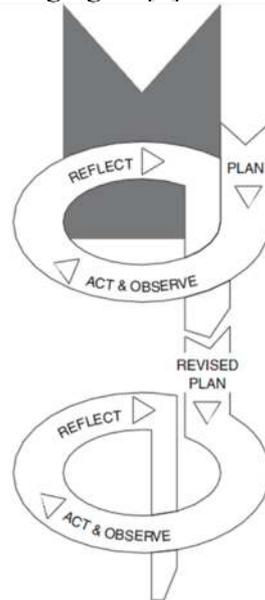

Figure 1. Kemmis and M. Taggart model

This research was planned to consist of three cycles which in each cycle it is expected that the achievement of success can reach a certain level described as follows.

Table 2. CAR Cycle Table and Its Success Indicator

Cycle	Level of Success
1	a. Application of the learning with troubleshooting method on Tune-up material for motorcycle practical learning. b. Observation of the learning process and its results c. Reflection, obtained the root cause of its advantages and weaknesses, and then create the next plan. Indicator of success: the average score of students' Tune-up competencies after the learning process reach at least 85. When average score is not reach 85, then the next cycle is applied.
2	a. Application of learning with the troubleshooting method on Tune-up material for motorcycle practical learning b. Observation of learning processes and its results c. Reflection, obtained the root cause of its advantages and weaknesses, and then create the next plan. Indicator of success: the average score of students' Tune-up competencies after the learning process reach at least 85. When average score is not reach 85, then the next cycle is applied.
3	a. Application of learning with the troubleshooting method on Tune-up material for motorcycle practical learning b. Observation of learning processes and its results c. Reflection, obtained the root cause of its advantages and weaknesses, and then create the next plan. Indicator of success: the average mastery score of students' tune-up competencies after the learning process reach at least 85. Until the third cycle, this target is expected to have been achieved.

The instruments used in this study consisted of:
1. Knowledge Test (Weight 30%)
   This test is based on the learning objectives to be achieved, used to measure how good their understanding towards the material of Motorcycle Tune-up. This test is executed at the end of each cycle with a weight of 30%.
2. Performance Test (Weight 70%)
   The test given is the individual task to identify and fix the trouble that occurs on a motorcycle that has been prepared by the lecturer before.

To find out and analyze the success rate or success percentage after the teaching and learning process, then an evaluation given in the form of a test or practical exam at the end of each cycle. For Student Learning Completeness, it can be seen from the results of the test whether it has met the specified competency standard or not, if it has fulfilled it means that the student has successfully mastered the material provided, and for Class Learning Completeness it is stated success when there is 85% of the total students succeed in achieving the specified competencies [9]. To find out if there is an development in a class, it can be seen from the class average score. The average score of the class is obtained from the sum of the scores obtained by students, which then divided by the number of students in the class so that the test average is obtained through the following formula.

$$\overline{X} = \frac{\sum X}{\sum N}$$

Dengan : $\overline{X}$ = *Average score*

$\Sigma\,X$ = Total score

$\Sigma\,N$ = *Total student*

3. Results and Discussion

From the assessment process which is executed when students did practical learning at the Motorcycle Laboratory, the results of competency assessment are obtained as shown in the table below.

Table 3. The Competency Assessment Results.

No.	Point of Assessment	1st cycle (average)	2nd cycle (average)	3rd cycle (average)
1.	Work Process	75.6	86.5	87.1
2.	Use of Tools	85.9	88.4	88.4
3.	Punctuality	83.3	75	85.8

Based on the results of the competency assessment in the table above, it can be described in bar chart in the following figure.
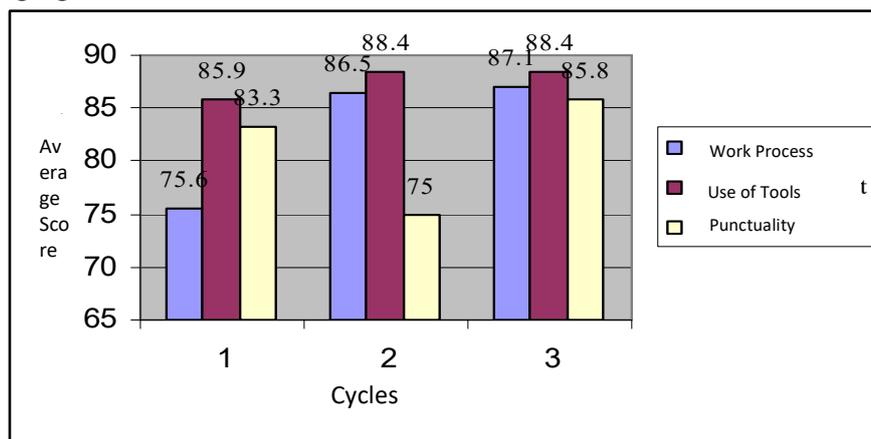

Figure 2. Diagram of the competency assessment results

Based on Fig. 2 it can be seen generally that in the first cycle the acquisition of work process average score was 75.6, in the second cycle the work process score was 86.5 and in the third cycle there was a work process score of 87.1. The aspect of the use of tools in the first cycle obtained an average score was 85.9, the second cycle was 88.4 and the third cycle was 88.4. The accuracy aspect in the first cycle was obtained at an average of 83.3, the second cycle was 75.0, and the third cycle was obtained an average score of 85.8.

From the aspect of the work process there is an increase in the average score, although the increase is not so significant but from the first cycle to the last increase. The use aspect of the tool has an increase in the average value from cycle one to the third cycle. In the aspect of average accuracy the score of the second cycle has decreased, but in the third cycle has increased so that from the results of the assessment it can be said that the competence of students in doing practice can increase from the first cycle to the third cycle. Based on the reflections carried out in cycle 2, the decline in the average score of timeliness was due to a lack of practices carried out by students, this occurred because the management of classes was not optimal. Besides that, it was also caused by weaknesses in forming

groups where the groups formed still tended to be homogeneous so that the collaboration process in learning by applying the troubleshooting method had not gone well.

Based on the results of these reflections, then the researcher made improvements which then the results of the improvements were implemented in cycle 3. The improvement results showed that every aspect had shown a good average score. This is evidenced from the average score of the work process aspects of 87.1, the use of tools 88.4, the punctuality of 85.8, if averaged the average score of the three aspects is 87.1. Student learning completeness in the third cycle was 88.5% where there were as many as 23 successful students from as many as 26 students overall. This means that the achievement of student learning outcomes has exceeded the indicator of success by 85%. The increase in the results of student competency assessment, especially in motorcycle practice subject, shows that the troubleshooting method has proven to be very effective when implemented in the learning process. Through the presentation of troubles tune-up real in the field, students can learn to solve these cases according to the standart operating procedure (SOP), thus student competency will be much improved and the learning process will be more meaningful. By learning based on real problems in the field (cases of trouble on tuning-up motorcycles), the final competency of students will be in accordance with the demands of the industries.

4. Conclusions

The troubleshooting learning method is one of the innovative learning methods that can help students improve their competency in motorcycle engine tune-up. This is evidenced from the results of the competency assessment obtained in the third cycle where the average score of the work process aspects was 87.1, the aspect use of tools was 88.4, and the punctuality was 85.8, so then the average score of the three aspects was 87.1, with student learning completeness of 88.5%. Motorcycle troubles-based learning allows students to get to know the real cases as early as possible in the field, work on performing engine tune-up procedurally through collaboration in groups guided by student worksheets.

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