

# Implementation of the Critical Thinking Concept as an Efforts to Strengthen Automotive Electrical Charging System Competency

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## **Implementation of the Critical Thinking Concept as an Efforts to Strengthen Automotive Electrical Charging System Competency**

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**Abstract:** One of the practical activities at automotive education program is the practice of automotive electrical System. The practice of automotive electrical system studies the electrical charging system used in motorized vehicles, which must be mastered as a provision of competency for automotive education teacher's candidate. Students are also required to have analytical skills in order to be able to carry out damage analysis processes or problems in the training object. The purpose of this applied research is to find out the results of automotive electrical competency learning with the application of critical thinking concepts on the worksheets used by the students. This research is a type of applied research in the field of education. The method used is qualitative and quantitative methods, so that information can be obtained from the effectiveness of the application of worksheets with the concept of critical thinking on learning outcomes. Results of applying the concept of critical thinking using analytical practice worksheets can improve automotive electrical competency seen from the results of student ability tests.

### **1 INTRODUCTION**

One of the vocational study programs is Automotive Engineering Education (PTO). PTO is one of the study programs in higher education that has the task to prepare students (students) to become teacher's candidate with automotive expertise.

One of the practicum activities of the PTO study program is the practice of automotive electricity and is a subject that must be taken by PTO students. Practice automotive electrical study electrical systems used in motor vehicles, which must be mastered as stock competency teacher candidates automotive engineering. Students are also required to have analytical skills in order to be able to do the analysis of damage or problems in the training object.

Practicum supporting learning tools that must be used are worksheets, manuals, while the manuals in them only display work procedures such as disassembly, inspection, assembly, maintenance, component names. students only follow the work procedures contained in the manual, while the manual does not contain questions and statements that must be filled with answers to the analysis by students. Current practice worksheets have not been

able to explore the practical analysis abilities, this is shown when the student's final exam is not able to provide an explanation to the examiner related to the problems that exist in the training object.

The facts in the field that the competency of automotive education teacher candidates, their analytical skills are still low and based on the thought that the importance of strengthening competencies by increasing students' analytical skills as supporting professional competencies of automotive teacher candidates, it is necessary to apply the concept of critical thinking using learning tools in the form of practical worksheets analytics so that the ability of practice and analytics is better and it's can strengthen it's competence in automotive electrical subjects. Identification of these problems, the low ability of the analysis of practice must be solved by applying the concept of critical thinking using analytic practice worksheets to improve analytical skills as a booster of automotive electrical competence will be the main study of this study.

This research has a contribution to education that all practicing students who have followed the practice of electrical system can have psychomotor abilities and analytical skills in making the diagnosis and decision making of a problem in a vehicle.

## 1.1 Vocational Learning

Djojonegoro (1998: 37) the characteristics of vocational education include vocational education preparing students to be ready to work; vocational education emphasizes the mastery of knowledge, skills, attitudes and values in the industry; the relationship between vocational education and the industry is very close; Vocational education requires good facilities for practicum.

Learning in vocational training is characterized by practical activities in workshops or laboratories, so that in accordance with its purpose is to prepare graduates who are skilled in certain fields and ready to enter the workforce. Practical activities include habituation processes such as the actual work that is packaged in vocational education.

## 1.2 Critical Thinking Concept

Every action or work requires a thought process, especially in carrying out practicum the thought process must continue to be done to get the answer to a problem. Thinking is an activeness of the human person which results in findings directed to a goal (Purwanto, 2007: 43).

Thinking is manipulating or managing and transforming information in memory which is make concepts, reason, and think critically, make decisions, think creatively, and solve problems (Santrock, 2008: 357). This practicum activity students must really utilize their thinking in carrying out the work and analyze it so that problems can be solved.

## 1.3 Analytical Ability

Bloom's taxonomy by Pardjono and Wardaya (2009: 260) which explains that the analysis is ability to break down information into smaller elements with a view to clarifying the element's content. Analysis is to describe something that has a large or general scope into small ones or a more specific scope (Sukmadinata, 2009: 271).

The ability to think critically is an ability that essential for life, work and functions effectively in all other aspects of life (Soeprapto, 2001). Problem solving in training objects when practicum must be accompanied by tangible evidence such as measurement and examination as well as the possibility that will occur, with the existence of such

evidence praktikan expected to be able to solve the problem.

## 1.4 Practice Ability

Learning through practicum activities can be interpreted as a process of developing and enhancing the affective, cognitive and psychomotor abilities of practicum participants through performance training after taking theoretical learning. Subiyantoro (2011: 7) explains that in terminology, practicum can be interpreted as a series of activities that enable someone to practice applying skills or practicing something.

Practical activities cannot be separated from a process of vocational education in the theory of Prosser and Quigley (1949) which states that vocational education will be (1) Efficient if the environment in which students are trained is a replica of the environment where later it works; (2) Effective if the tasks, training work is carried out in the same manner, device, and machine as required in the job; (3) Effective if practicing habits of thought and work as in DU-DI; (4) Effective if every individual capitalizes on their interests, knowledge and skills at the highest level.

## 1.5 Practice Worksheet

According to Prastowo (2011) worksheets have at least four functions in learning activities as follows (1) as teaching material that can minimize the role of educators but more activates students, so learning is more student-centered; (2) as teaching materials that make it easier for students to understand the material provided; (3) as teaching materials that are concise and rich in the task of practice; (4) facilitate the implementation of learning to students.

Practical worksheets also support teachers and instructors in learning, according Yahya (2014: 32) states that a practical worksheet (jobsheet) is an educational media technology that is printed to support instructors in learning skills especially in workshops or workshops, the contents of which is a set of instructions, directions and pictures about how to complete a job while practicum.

## 1.6 The Concept of Critical Thinking on a Practice-Analytic Worksheet

Brown (1998) in Pardjono and Wardaya (2009: 259) which states that learning methods based on problem solving can improve basic skills and thinking skills. This analytic practice worksheet can guide the

practitioner in finding problems and overcoming problems in the training object because of open questions. Analytic practice worksheets are worksheets that are used when students practice to guide thinking in understanding work concepts, finding problems and overcoming problems of a system or component.

Some other studies that are relevant to this study include research conducted by Febriana, et al (2013: 5) that student worksheets with a problem-solving approach can optimize students' critical thinking skills and can be used as a support for physics teaching and learning. The analytic practice worksheets in this study were also equipped with material, pictures, work procedures, and questions, so as to stimulate the critical thinking skills of the practitioner.

Research conducted by Yahya (2008: 36) explains that practical worksheets (jobsheets) must have an attractive appearance, the need for a complete list of equipment, work order sentences that are easily understood by the practitioner. The results of the study also recommend that instructors on practical material must use a job sheet so that learning objectives can be achieved. The characteristics of vocational education is preparing students to be ready for work; Vocational education emphasizes the mastery of knowledge, skills, attitudes and values in the world of work (Salirawati et al, 2011: 99). In addition to the practice of students, they are also equipped with analytical skills, which are provisions to solve all problems in the field with the right steps.

Practical activities will produce a good output, if supported by devices, learning media, adequate infrastructure, one of which is a practical worksheet. Worksheets that are sheets containing tasks that must be done practiced in accordance with procedures, so that practitioners are more active to practice and guide in solving problems when practicum (Majid, 2008: 176) and (Yahya, 2014: 32).

Based on a theoretical study and structural of thinking, the hypothesis based this study of the application analytical practice worksheets is effectively increasing the competency of filling system electrical practices.

## **2 RESEARCH METHOD**

### **2.1 Research Design**

This research uses quasi experimental research design. This design has a control group, but it cannot function fully to control external variables that affect the implementation of the experiment (Sugiyono, 2009: 77). Control is only carried out in accordance with existing conditions. The two groups are classes with relatively the same subjects, both the number of practitioners, educational background of vocational schools, length of time of study, the form of study rooms, the same learning media. Noting the above description, the selected quasi experimental design is the posttest control group design (Sugiyono, 2009: 79).

### **2.2 Operational Definitions of Research Variables**

The variables of this study consisted of independent variables was the application of analytic practice worksheets, while the dependent variable was the competence of the electrical system practice practices.

### **2.3 Population and Research Samples**

The subjects of this study consisted by population and samples in the Department of Mechanical Engineering, Faculty of Engineering, Semarang State University. The population in this study were all students in 2016/2017 semester of the Automotive Engineering Education study program. The sampling technique in this study uses purposive sample technique. Purposive sample is done by taking subjects not based on strata, random, or region but based on the existence of certain objectives (Arikunto, 2006: 139-140).

Based on the sampling technique and some considerations including in accordance with the research design there are experimental classes and control classes, the class that will be the sample of the study is practicing students who take electrical group 1 and 2 engine classes, which total 43 practices as control classes while group 3 and 4, totaling 46 practitioners as the experimental class.

### **2.4 Place and Time of Research**

The research was carried out in the automotive electrical workshop of E9 building, Department of

Mechanical Engineering, Faculty of Engineering, Semarang State University. The time of the study began from the submission of proposals in March to the completion of the research report. This research was conducted from March 2017 June 2017.

## 2.5 Collecting Data Techniques and Research Instruments

### 2.5.1 Collecting Data Techniques

Collecting data techniques that used in this study are quantitative & qualitative methods. Worksheets were submitted to each practitioner given twice, namely before treatment (pre-test) and after treatment (post-test).

### 2.5.2 Research Instruments

The instrument used an analytic practice worksheet submitted to the practitioner to fill out. The instrument of interest study consists of practical abilities and analytical skills. Meanwhile the validity of this instrument consists of the validity of the construction and contents.

The reliability testing of this instrument is done internally and is calculated by the Cronbach Alpha formula, because the instrument's score is a range of several values. The answer score is between 1-5. The Cronbach Alpha formula (Sugiyono, 2014: 365) is as follows:

$$r_i = \frac{k}{(k-1)} \left\{ 1 - \frac{\sum S_i^2}{S_i^2} \right\} \quad (1)$$

Information:

- $r_i$  : Instrument reliability coefficient
- $k$  : Number of items in the instrument
- $S_i^2$  : Number of variance scores for each item
- $S_i^2$  : Total variance

Testing of instrument reliability uses the reliability test with the Cronbach Alpha technique with the help by SPSS 16.0 for Windows program. In the SPSS program, this method is done by the Cronbach Alpha method, where a questionnaire is said to be reliable if the Cronbach Alpha value is greater than 0.60 (Santosa and Ashari, 2005: 251).

## 2.6 Research Procedure

The research procedure in this study includes the stage of research preparation and the stage of research implementation. The research preparation includes study location readiness survey, determine experimental material, making teaching materials for treatment, make a research proposal, manage licensing, determine the experimental class and the control class. Stage of research implementation include giving treatment and giving a post test.

## 2.7 Data Analysis Technique

The data analysis uses test requirements analysis which consists of several types of tests, namely the normality test, homogeneity test. The statistical technique used in hypothesis testing is the t test. Data processing uses SPSS 16.0.

### 2.7.1 Normality Test

Before conducting data analysis, the normality of the data must be tested first. This test is subject to learning outcome variable data before and after treatment. The data normality test is performed using the Kolmogorov-Smirnov one sample test.

As for the criteria in this test, at a significance level of 5% or 0.05, the data is declared to be normally distributed if the significance is greater than 5% or 0.05, and vice versa.

### 2.7.2 Homogeneity Test

The test used in the homogeneity test is the F test, the F test formula is intended as follows (Sugiyono, 2014: 140-141).

$$\frac{F_{LARGEST}}{F_{SMALLEST}} \quad (2)$$

The criteria in this test is that if the F count is smaller than F table, it can be said that the sample is homogeneous or vice versa.

### 2.7.3 Early Learning Outcomes

Measurement of student learning outcomes before treatment is intended to get a score of student learning outcomes in the experimental class and the control class before treatment, so it is known whether the learning outcomes of the experimental class and the control class there is no difference

before the treatment. Testing learning outcomes before treatment using the t-test formula.

### 2.7.4 Research Hypothesis Test

Testing the hypothesis used in this study is the t-test. So, to analyze the data in this study used a comparative two-sample t-test formula. If the t-value > t-table with alpha 5%, then Ho is rejected and Ha is accepted, and if the t-value < t-table with alpha 5%, then Ho is accepted and Ha is rejected. For the calculation and processing of data in this study was carried out using SPSS 16.0 for Windows.

## 3 RESULT

### 3.1 Research Result

The results of the practical test for the filling system of the experimental group received an average of 79,861 while the control group received an average of 74,111.

Table 1. Average Results of Practice Ability Students.

Students	Filling System
Experiment	79,861
Control	74,111
Average	<b>76,986</b>

Practice test results show different results between the experimental group and the control group, where the average experimental group is higher than the control group. In order to know whether there are differences between the experimental and control groups, an average difference test can be performed. Before conducting the average difference test, the prerequisite tests are carried out with homogeneity and normality tests. Homogeneity test results showed that the two groups namely the experimental group and the control group had homogeneous variants and the data distribution was normally distributed.

The next analysis is the average difference test. The average difference test of the filling system practice test results shows the calculated t value obtained from the calculation of 2.171 and the t table value of 1.994. If t arithmetic is greater than t table, t arithmetic > t table namely: 2.171 > 1.994, then Ha is accepted. This means that there are significant differences in the average results of ignition system practice tests between the two experimental and control groups. The results of the different abilities of practice showed that the practical ability of the

experimental group was higher than the control group.

The next step is to find out the analytical skills of practicum which are the hallmarks of LKPA. Analytical skills are obtained through analytical skills tests that are carried out after the practicum. After conducting the test, the data are then analyzed to find out the average analytical ability score. In table 4.2, the results of the analytical ability test for the charging system of the experimental group averaged 86.38, while the control group score averaged 55.38. In order to know the difference in average scores between the experimental group and the control group, an average difference test is performed. Before conducting the average difference test, a prerequisite test is used to determine the homogeneity of the variance and the normality of data distribution. Homogeneity test results showed that the two groups namely the experimental group and the control group had homogeneous variants and the data distribution was normally distributed.

Table 2. Average Score Results of Analytic Ability Students.

Students	Analytical Filling System
Experiment	86,388
Control	55,388
Average	<b>70,888</b>

The next step is to test the average difference from the analytical ability score using the average difference test. The average difference test results of the analytical ability of the filling system shows the calculated t value obtained from the calculation of 25.631 and the t table value of 1.994. If t arithmetic is greater than t table, t arithmetic > t table or 25,631 > 1,994, then H0 is rejected and accepts Ha. This means that there is a significant difference from the average ignition system analytical ability test results between the two experimental and control groups. More details can be seen in Appendix 8. Based on analytical ability test scores, the experimental group was higher than the control group and the average difference test results showed the test scores of the two groups were significantly different, so it can be said that the LKPA developed was effective in strengthening competency.

The analytical ability test instrument used is a valid and reliable instrument. The test results are known that the analytical ability test instrument is valid, because all items have a calculated Pearson Product Moment value above the criteria of 0.30. The reliability test results showed that the analytical

ability test instrument that was applied was reliably used, because it obtained a Cronbach-Alpha calculated value above a critical value of 0.60.

### 3.2 Discussion

Testing the effectiveness of the developed LKPA products is obtained from the results of practical tests and analytical skills tests in automotive engine electrical practice classes. The results obtained state that the practice test for the filling system of the experimental group was higher when compared to the control group. The difference in the results of these tests, certainly due to the treatment using LKPA in the experimental group and practicum who come from the experimental group can answer the analytical questions that have previously been practiced during the practicum process. This is supported by Bakirci et al (2011: 1468) who explained that simulations will have a positive effect in combining students' thinking abilities. This is in line with the research of Mahmuzah et al (2014: 51) that the mathematical critical thinking ability of students who obtain learning with the problem posing approach is significantly better than students who obtain conventional learning. The research is supported by Magfiroh et al (2011: 7) which states that analytical thinking encourages students to use the knowledge they have acquired to analyze the benefits and losses that will result.

LKPA is effective to strengthen analytical skills if it is based on learning outcomes. LKPA is effective because it can be a direct guide to practicum objects in practicing analytical skills, so that the practitioner is accustomed to and easy to find the cause, diagnose the consequences and solve the problem. This is in line with Kisiel (2003) which states that worksheets can direct students to the intended material in a learning activity in the form of observation, by focusing on objects that are directly related to learning objectives which then impact on increasing learning outcomes.

Analytical skills in LKPA can be interpreted as the ability of the practitioner to diagnose to determine the damage that occurred, find the cause, analyze the causes with the effects that can occur and can find solutions to damage to the training object. Pardjono and Wardaya (2009: 267) in their research explained that students were able to focus on problems and then look for solutions that were increasingly conical and more precise and were able to focus thoughts on a particular component in a system consisting of many components, how each

component works, the effect of components on system and the consequences if these components do not work well. This is in line with the learning approach constructed by involving students in problem situations and finding the cause of the problem and providing alternative solutions to solve the problem, choose one of several references that are appropriate and finally get answers to solve the problem (UNESCO, 1992: 28).

LKPA which is used in the practicum process allows the practicums to get used to working in accordance with procedures and to train and to stimulate analytical thinking skills to solve problems or diagnose damage that can occur in the training object, so that prospective teachers will be represented and their competence will improve. If related to the Prosser theory which states that vocational education will be effective if the education and training process get used to working and thinking properly. Research is in line with Triyono (2008: 13-15) if analytical skills are higher it will improve student skills. If prospective teachers have been accustomed to have analytical skills, then in other practicum activities it would be more effective. Boyatzis (2007: 8) explains that if you have analytical skills, it will make an activity more effective. A prospective teacher must have good competence so that later they can develop students' abilities. This is also supported by Abao (2014: 339) that teachers must have competence in good learning in developing students' thinking abilities. Through this analytic practice worksheet, the analytical skills of prospective automotive teachers will increase and their competencies strengthen.

### 3.3 Research Weakness

This research has weaknesses including (1) analytic practice worksheets limited to the course of electrical practice engines that focus on conventional filling system material; (2) The subjects applied by LKPA are limited to PTO study program students; (3) not all types of vocational education can directly use this analytic practice worksheet without any prior adjustments.

## 4 CONCLUSIONS

Based on the results of research and discussions that have been carried out, it can be concluded that: Analytic practice worksheets are media that can be used to apply the concept of critical thinking. Meanwhile the application of the concept of critical

thinking with LKPA can strengthen automotive electrical competence in the filling system, which indicated by the difference in the results of the ability tests of the experimental group higher than the control group.

After knowing all the results of the research, the suggestions that can be submitted are as follows: (1) LKPA can be used in every practicum activity, (2) there is the development of LKPA with broader material.

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