Analyzing Students’ Problem Solving Difficulties on Modern Physics

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Abstract: Problem solving is the most important skill which physicists should have. A research about problem solving skill in physics instruction was significantly essential because physics students have to comprehend concepts and recognize how to cohere it. By those comprehensions, students would be ingenious to solve the physics problem. The purpose of this study was to analyze students’ problem solving skill which is based on problem solving step by Polya. The study was an initial research for the next developing research about implementation of a learning model in physics instruction to increase the students’ problem solving skill. Subjects of research were college students of physics education department, who had taken modern physics subject. Data was analyzed by using qualitative-descriptive method. The research revealed these following conclusion: (1) college students had difficulty to comprehend the problems and hard to plan a solution (2) lecturer should apply a model of learning which train the students’ problem solving skill in physics such as cooperative problem solving model.

1. Introduction
The success of college students is the main aim in education process on tertiary education level. Students who do not reach success learn allegedly caused by many factors. Among them are inappropriate learning method, choosing method and lecturer approach that have not quite suitable with students’ situation, the lack of supporting facilities, or others. So that it requires an evaluation for measuring the success. The evaluation activities is intended to know the result from the learning activities that has been conducted, and based on the result, it can be determined that the follow-up action that should be done next.

Based on the early observation result through lecturer’s observation when Modern physics subject took place in one of the classes in Physics Education Study Program of West Sulawesi, it is known that there are some barriers experienced by lecturers and students. One of them is that the constraints faced by students, which is an average student tend to experience difficulty in solving problem; it can be proven with 19 of the 31 students still get final score in Modern Physics at below 70. This subject always presents a problem that demands its college students to think critically and systematically for completing various cases in the domain of modern physics. The characteristic of this subject is very identical with physics lesson in middle school that demands students to be able to think critically and systematically.
The material in Modern physics subject is the material that connects between classic and modern theory (quantum). Without a good understanding in this subject, then it can be confirmed that college students will not be able to understand deeper physics material and more complex e.g. physics quantum material. Therefore, a lecturer should be able to create a good evaluation model, i.e. model that is able to measure students’ ability in solving problem systematically that covers the ability to understand problem, plan solving strategy, as well as the implementation of that strategy.

Moreover, the result of the initial observation shows that the problem that happens on college students when solving modern physics problem is that they are not able to connect physics concept between one and other concepts. This appears in students’ disability in solving modern physics exercises in the form of story that is given by the lecture. When college students are given exercises, they look like confuse and do not know what to do. This is because they do not understand the questions that are asked. Besides, most of the students do not work systematically and lack of attention towards the solving steps. Students only think about the final answer of the exercise, so that there are lots of ways that are abandoned, even that is a step that determines the final result of an answer.

In line with that matter, this research would like to study one of the theories of problem solving that is done by George Polya, where George Polya implement the solving steps of a problem in more systematic way. He shows the problem solving that is not only interesting, but also intended to convince about the concept that has been learned when the teaching and learning process is on its progress.

The research about problem solving that has been stated by [1] on National Physics Symposium 2014 in the journal entitled “The Students’ Difficulties in Solving Physics Problem”. This research shows that the students experience a difficulty in solving problem because they have difficulties in understanding the problem and do not know the strategy to solve the problem.

Another research also has been done by (Wenning, 2002) in international journal entitled “A Multiple Case Study of Novice and Expert Problem Solving in Kinematics with Implications for Physics Teacher Preparation”. In that research, it is stated that the majority number of students experience difficulties in solving problem, such as: (a) lack of using a method systematically in solving certain problem, (b) failure in identifying known variables, (c) making mistake in algebra.

Before finding a solution from the above-mentioned problem, the writer needs to analyze further about how is the students’ difficulty in solving problem when working on a research entitled “The Difficulty Analysis of Modern Physics Subject for Students of Physics Education in Western Sulawesi University”.

Based on the background of the research above, so that the formulation of this research problem is that:

1. How is the difficulty of Physics Education Students in Western Sulawesi University in solving the problem of Modern Subject?

2. How to prevent and solve the difficulties that are experienced by students of Physics Education Study Program in solving problem in Physics Modern subject?

2. Review of Literature

The ability of solving problem is a way to implement knowledge that was previously acquired into a brand new different situation [2]. Khaeruddin et al.[3], declares that the ability to solve problem also can be determined as the ability of an individual or group to find answer based on the previous understanding in order to fulfill the normal situation. Ledesma[4] said that problem can be requested towards students through verification process, also the knowledge transfer can be acquired through the previous course. According to Sambada[5] problem solving can be interpreted as a process of deleting the existing problem, where in the inside there is a relation concept that are received in solving problem. The problem solving of physics is a solving method towards a number of tasks that are related to physics, while your ability to solve problem in physics subject is the ability to use a certain method to finish a number of tasks in physics subject. The ability to solve problem leads to the necessary effort of students in determining solution towards the problem that they face [6]. Based on
those arguments, it can be concluded that the ability to solve problem is the ability in harnessing any information that are available and by using certain learning method in determining about what should be done and finished to get the solution from a problem.

According to Polya[7], solving problem has four solving steps, namely: (1) understand the problem, (2) devising a plan, (3) carrying out the plan, (4) looking back.

Moreover, Styer (2012) stated that the steps that are used to solve physics problem are divided into three steps, i.e. (1) design a strategy, (2) execute strategy, and (3) check the answer.

3. Methods
This research is a qualitative-explorative research. This research has purpose to explore the difficulty in solving problem of modern physics materials.

Overall, the procedure or steps of this research can be described as follows: (1) Planning research instrument; (2) Determining research subjects based on (a) Pre-Test and, (b) GPA, and (c) Modern Physics Lecturer’s recommendation; (3) Data collection, covers (a) giving a pre-test sheet to physics education student that has programmed modern physics subject, to be used as a guidance to determine research subjects by choosing subjects by score interval that has a high, medium, and low (c) giving problem solving in the form of draft towards research subjects. The subjects work on the problem that is given while they are being interviewed, (d) analyze the difficulty that is done by students, and (e) triangulation; (4) data analysis, covers (a) pre-test result analysis. (b) analyze the result of difficulty test in solving physics problem that is given for each number and (c) analyze the result of the interview; (5) Arranging exploration implementation (the discussion of analysis result) of the difficulty of physics problem towards students of physics education in Western Sulawesi University; (6) Composing the report of the research result. The result that is hoped is a result that can explain what are the difficulties that are faced by students of physics education in Western Sulawesi University in solving problem on modern physics subject as well as how to prevent and solve that difficulty.

The flow of the research can be described in the following chart

![Flowchart](image)

**Figure 1.** The flow of the research

4. Result and Discussion
As stated in the previous section that this research is a qualitative-explorative research. This research describes the actual condition of research subjects that is related with students’ difficulty in solving problem of modern physics. The data collection in this research uses pre-test towards students, i.e. by giving a number of exercises that are taken from modern physics material. The pre-test result will be
used as a foundation in taking research subjects, grouping research subjects are done based on the pre-test result of students that are existed in score interval that are categorized as high, medium, and low. From 25 students, the research subjects will be chosen 3 students that each of them represent students with its category (high, medium, and low). To explore students’ difficulty in solving problem, so that interview towards three research subjects is conducted.

| Table 1. The Result of the Problem-Solving Difficulty Test |
|-----------------------------------------------------------|
|   N   | Scoring Aspect           | Percentage of Difficulty in Solving Problem |
|------|--------------------------|---------------------------------------------|
| 1    | Understanding the question | 78%                                         |
| 2    | Completion plan           | 67%                                         |
| 3    | Implementation of the Plan| 67%                                         |
| 4    | Review/Evaluation         | 100%                                        |

Based on table 1, it is known that from three research subjects (A, B, and C) 78% or the majority of subjects experience difficulty in understanding modern physics questions that are given. Then, in the second and third step from the completion plan of Polya, the subject has equal difficulty percentage i.e. 67% with majority category experience difficulty in planning and implementing the problem solving. In the last step namely review/evaluation, all subjects experience difficulty with total percentage of 100%.

From several phases of interview that has been done, the researcher can be concluded that:

Subject (A) experience difficulty in solving problem on the question number 1 according to Polya phase. Subject (A) experience difficulty in solving problem on the question number 2 especially in the phase of solving problem, the phase of solving problem, and evaluation phase. Subject (A) experience a difficulty in solving problem of the question number 3 especially in the last phase from four total Polya phases.

Subject (B) experiences difficulty in solving problem in the question number 1 according to Polya phases. Subject (B) has difficulty in solving problem of the question number 2 particularly in the phase of solving problem plan, problem solving phase, and evaluation phase. Subject B has difficulty in solving problem of the question number 3 mainly in the last phase of four Polya phases.

Subject C experiences difficulty in solving problem of the question number 1 according to Polya phases. Subject C doesn’t have any significant difficulties in solving problem of the question number 2. Subject C experience difficulty in solving problem of the question number 3 particularly in the third phase and fourth phase of Polya phases.

5. Conclusion
Based on the results of the study and discussion, it can be concluded that:

a) The majority of the students in physics education study program of Western Sulawesi University experience difficulty in solving problem on modern physics with percentage; 78% students feel difficult in the phase question understanding, 67% students feel difficult in completion phase, 100% students feel difficult in the phase of review/evaluation.

b) One of the solutions in solving problem that is faced by students of physics education study program in western Sulawesi University in solving problem of modern physics subject is to implement a learning model that is suitable e.g. the cooperative problem solving learning model.

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