Analysis of Problem Solving Ability Judging by Scientific Work of Science Education Students

Ellyna Hafizah, Rizky Febriyani Putri, and Syubhan Annur
Science Education Department, Faculty of Teacher Training and Education, Universitas Lambung Mangkurat, Banjarmasin, Indonesia

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Abstract: This study aims at examining the relationship between capabilities of problem solving and student's scientific work. This research was conducted in even semester of academic year 2017/2018. Sample in this research was a whole students of science education IPA batch 2015 who were taking basic electronics subject with the amount of sample was 44 students. The research instruments in this research were used in the form of problem solving test problem and observation sheet of student scientific work. Data analysis has been done by using prerequisite test of linear regression model, test of correlation coefficient Pearson/Product Moment formula, t-test of correlation coefficient, and coefficient determination. The result of this study indicates that there is a significant relationship between problem solving abilities and student scientific work. It means that the higher the student's scientific work the higher the student's problem solving ability.

1 INTRODUCTION

Nature of science is a body of knowledge that is arranged in a systematic. The development of science is not only characterized by the existence of a collection of facts, but also marked by the existence of scientific methods and scientific attitudes. Besides nature of science is studies the symptoms through a series of scientific process built on the scientific attitude and the results are manifested as a scientific product that is composed of three essential components in the form of concepts, principles, and theories that apply universally(Trianto, 2010). Based on the explanation, nature of science is the science that was born and developed through the steps of observation, problem formulation, formulation of hypotheses, testing hypotheses through experimentation, inference, as well as the discovery of the theory and concepts.

In general, the process of science education has two components, the content and process. Content related to the structure of knowledge while the process is a necessary skill to acquire, implement, and generate knowledge. Most schools and colleges, leaving emphasis process to the level of understanding of students and higher students. The reason is the students need to get the facts before they can apply it. This often makes science into static and trigger an action that deviates so that the passing standards achieved. With the teaching conditions, students follow instructions without contributing thoughts on what they have learned or how it can be applied. The result is a general apathy and frustration toward science (Zawadzki, 2010).

The existence of apathy and frustration toward science require an effort to improve the learning process. Teaching and learning strategies should be directed to the activity so that students can master the concepts in the learning process of science. According to Alkrismanto (2003), in other words an active process of people who are learning or student activity will provide opportunities for students to use the thinking skills to achieve results that are more meaningful.

The essence of good thinking skills is the ability to solve problems. The basis of problem solving is the ability to learn in situations of thought processes. The success of the problem-solving process is strongly influenced by students' thinking skills (Meador, 1997). High thinking skills of students will give success to solve problems more effectively (Ozden & Gultekin, 2008).

Research related to problem-solving ability in science is focused on two main topics (Caliskan, 2010). The first is the study of comparative and problem-solving behavior differences between expert and novice troubleshooter. The second is about problem-solving strategies to make students become

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problem solvers. Experienced problem solvers tend to need a little time to solve problems. Usually an experienced problem solver in solving the problem is not always robust to a breakdown structure but uses the concepts that have been obtained previously and associate into a unity that support. An experienced problem solver requires less time than a less experienced in solving problems.

Problem solving is a fundamental part of science learning at schools. After the teacher introduces the concept, students use the concept in the problem (Ifamuyiwa, 2011). Learners require different stages of resolving a problem that is passed. The existence of stages in solving this problem to make learners not only require the concept of cognitive (minds-on) but also an activity (hans-on).

The skill that combines minds-on and hans-on according to Wenning (2007) is scientific work. Scientific work is actually an extension of the scientific method and defined as a scientific inquiry applied in action in learning science and in life (Wenning, 2011). Furthermore, scientific work is a powerful way to understand the concept of science. Scientific work is an activity that refers to the ways scientists in studying the world and provide an explanation based on the fact the work such as designing experiments, collecting data, analyzing data, providing an explanation of the data, present the results of the experiment, and concluded (Wenning, 2007). Under these conditions, the scientific work is a skill that can be trained.

The relationship between problem-solving skills with scientific work that is owned, so it is necessary to analyze the problem solving scientific work of students in terms of science education.In addition, research conducted by previous researchers found that the students problem solving abilities science education is still relatively low.

2 METHODOLOGY

The design of this study is a correlational study that aimed to find the relationship between the problem solving and scientific work of students without first giving any treatment. The subjects were Science Education Department of Universitas Lambung Mangkurat students of 2015. The study was conducted on April 2018 and May 2018.

The research instrument used was the problem solving instrument test and scientific work observation sheet. Problem solving ability data obtained through the test activity, scientific work data obtained from the observation sheet during the lecture took place.

The analytical techniques used in this study using simple regression analysis (ANAREG). Data processing is done manually by using Microsoft Excel without the help of certain statistical software. Linearity test prerequisite test done before the data is processed. After the test prerequisites are met, then test ANAREG simple linear equation as follows:

$$Y = a + bX \quad (1)$$

Explanation:
Y = Kriterium
X = Prediktor
a = Intersep (konstantaregresi)
b = Koefisienregresi
(Winarsunu, 2015)

The next data process is the correlation coefficient test using thePearson/Product Moment equation.

$$r_{xy} = \frac{\sum xy}{\sqrt{\sum x^2 y^2}} \quad (2)$$

then use the *t* test to see the correlation coefficient.

$$t_{hitung} = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}} \quad (3)$$

If $t_{hitung} \geq t_{tabel}$,then H_0 is significant, and vice versa. If the correlation coefficient is significant, the influence between variables can be obtained with a coefficient of determination.

$$D = (r_{xy})^2 x100\% \quad (4)$$

Guidelines to provide interpretation of the correlation coefficient obtained from the calculation results can be seen in Table 1 below:

Table1: Guidance Interpretation of Correlation Coefficient

Interval Coefficient	Relationship Level
0.00 – 0.199	Very low
0.20 – 0.399	Low
0.40 – 0.599	Medium
0.60 – 0.799	Strong
0.80 – 1.000	Very strong

(Sugiono, 2012)

3 RESULTS AND DISCUSSION

Data of problem solving ability obtained through post test in the form of essay matter, scientific work data obtained from the observation during learning activities were conducted. Once the data was obtained, the next step is to find a correlation between the data. Before the data is analyzed by simple linear regression model first tested the linearity of the data problem-solving ability and scientific work of students. Complete linearity test results are shown in Table 2.

Table 2. Linearity Test Results

Parameter	Scientific Work(X)	Problem Solving Skill (Y)	X^2	Y^2	X*Y
∑	3235	3160.889	240175	229823.4	234518.6
JKt	229823.4				
Jka	227073.1				
B	0.910878				
A	4.86815				
JKb	1932.349				
Jkres	817.8922				
JKg	772.26		dbg	37	
JKtc	45.63215		dbt	5	
Rktc	9.126431				
RKkg	20.87189				
F_{hitung}	0.437259				
F_{tabel}	2.48				
Status	Linear				

Based on Table 2 above shows that Fhitung<Ftabel, it means that both data are linear. This shows that the scientific work can predict problem-solving ability of students and showed systematic changes. Systematic score changes show that most individuals experience a score change in the same capacity (Winarsunu, 2015).

The next analysis is to obtain a simple linear regression equation as a whole. Based on Table 2found that the value of a = 4.87 dan b = 0.91 so that a simple linear regression equation obtained is:

$$Y = 4.87 + 0.91X \quad (5)$$

Based on the above equation, it appears that the value of b is positive. It means that the increment is linearly proportional. The higher the value of X (scientific work) the higher the value of Y obtained (problem solving skill).

Data of scientific work and problem solving skills that have been obtained subsequently determined the level of correlation between the two with a correlation coefficient using the formula Pearson/Product Moment. This correlation test calculation results as a whole are presented in Table 3 below.

Table 3.Correlation Test Results and Coefficient of Determination

Parameter	Science Work(X)	Problem Solving Skill (Y)	$(X-\bar{X})$ x	$(Y-\bar{Y})$ y	x^2	y^2	xy
∑	3235	3160.889	3E-13	0	2329.0	2750.2	2121.414
Average	73.52273	71.83838					
r_{hitung}	0.838219						
r_{tabel}	0.297						
Status	Positive correlation						
t_{hitung}	9.961379						
t_{tabel}	2.021						
Status	H_0 rejected						
D	70.26%						

Based on Table 3, it was found that rhitung value of 0.84, which means that the problem solving ability of students overall have a very strong relationship with the scientific work of the student. It means that the higher the scientific work of students, the higher problem-solving ability possessed, and vice versa.

Having obtained a correlation coefficient of 0.84 will be determined coefficients are significant or not with t test. Based on Table 3 above shows that thitung>ttabel (9.96 > 2.02) it means there is a significant relationship between student problem solving skills with scientific work.

Based on Table 3 also shows that the coefficient of determination of data problem-solving abilities and scientific work of students amounted to 70.26%. It means that the contribution of scientific work to students problem solving ability is 70.26% and 29.74% by other factors.

The results obtained show that the process of problem-based learning is able to foster scientific work and problem solving skills. This is in line with the results of Ulfa's study (2015) which states that students who learn with problem-based learning strategies can be relied upon in terms of problem-solving skills. The use of problem-based learning strategy provides an opportunity for students to more quickly in solving problems, with the completion of the steps that can be trained. Problem-solving skills are also supported by its own students' beliefs about learning undertaken that such learning is not as difficult as imagined.

Problem-based learning activities proven to improve the problem solving and scientific work of students.This problem-based learning allows students to understand and construct their own knowledge and understanding through a series of learning experiences that passed, so it can reflect the results obtained with the knowledge and understanding that has been previously owned (Akcay, 2009). In addition, problem-based learning is also able to improve variety of other soft skills such as learning motivation, communication skills, collaboration and make an independent learner (Surif, 2013).

The problem solving and scientific work that can be trained in the learning process make the learning process should be designed so that both these capabilities can be improved. The problem solving and scientific work is the ability to support to make students independent learner. Independent learners who are able to face the real problems in life as the ultimate goal of a learning process.

Problem-solving skills and scientific work also have real relevance. Students who have high scientific work also had high problem-solving ability (Sitika, 2015). This is because in a problem-based learning, students are faced with a problem that must be solved with the steps and scientific methods. Problem solving process iscan not be separated from the processes, where the student have to identify the problem to be investigated, to make a hypothesis, make predictions generalization of hypotheses, designing experiments, conducting experiments, observations to test hypotheses (identifying an experimental systems, identifying and defining variables, control experiments or observations), collect data, organize data, and analyze data (analyzing data to find relationships, interpreting graphs, developing factual laws using a graphical methods), using a statistical method to construct conclusions, explain the results do not match, said the results of the experiment. All these steps are part of the scientific work indicator that has been said by Wenning (2007).

4 CONCLUSIONS

Based on the research result and the results of hypothesis test that has been done, it can be concluded that there is a strong relationship between problem-solving skills with scientific work of students.The higher the scientific work that owned the higher the students problem solving abilities.

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