THE CORRELATION BETWEEN MASTERY OF PHYSICS CONCEPTS AND CREATIVITY WITH PROBLEM-SOLVING ABILITY IN STATIC ELECTRICITY

Bajongga Silaban

University of Setia Budi Mandiri Medan,
INDONESIA.

bajongga.silaban@yahoo.com

ABSTRACT

This research are aimed to know what was the correlation between mastery of physics concepts with problem-solving ability, creativity with problem-solving ability and mastery of physics concept and creativity with problem-solving ability on static electricity on Nasrani 1 senior high school Medan. The samples are students for grade XII natural sciences who had studied a static electricity as material consisted of 25 students were selected using purposive sampling. The type of research is a correlation research by mastery of physics concepts and creativity as an independent variable and problem-solving ability as a dependent variable. The instruments used for data collection were physics learning-outcomes tests and questionnaire surveys. Descriptive statistics, regression analysis, correlation analysis, and one-way analysis of varians (ANOVA) were used to analyze data. Based on results of data analysis, it is obtained that: 1. mastery of physics concepts and problem-solving ability be good-classified, meanwhile the student's creativity be medium-classified and problem-solving ability be best-classified, 2. there were strength of positive correlations which is significant between mastery of physics concepts with problem-solving ability, creativity with problem-solving ability, and mastery of physics concepts and creativity simultaneously with problem-solving ability on the material of static electricity for grade XII natural science students of Nasrani 1 senior high school Medan.

Keywords: mastery of physics concepts, creativity, problem-solving ability, static electricity

INTRODUCTION

In Education Unit Level Curriculum poured the objectives of high school physics in which students have the ability to form a positive attitude towards physics by realizing the regularity and beauty of nature and glorify the greatness of God Almighty; cultivate a scientific attitude honest, objective, open, tenacious, critical, and able to cooperate with others; gain experience in applying scientific methods through experiments or experiments; raising awareness of the application of physics that may be beneficial and harmful to individuals, communities and the environment and realizing the importance of managing and conserving the environment for the welfare of society; understand the concepts, principles, laws and theories of physics and their interrelations and their application to solve problems in daily life and technology (Mulyasa, 2006).

Based on results of National Examination of the academic year 2015/2016 Nasrani 1 senior high school Medan for 3 subjects natural science obtained average value of physics 6,90; average of chemistry value 7,24 and biology average 7,95 (Nasrani 1, 2016). This indicates state there are still in school any students who do not mastery to solve of physics problems and does not create a high sense of creativity so that fails in solving physics problems which

Leena and Luna International, Chikusei, Japan.
(株) リナアンドルナインターナショナル, 筑西市,日本
ISSN: 2186-845X ISSN: 2186-8441 Print
www.ajmse. leena-luna.co.jp

directly affect the learning outcomes of student grades below 7,0. This is still slightly less the Minimum Exhaustiveness Criteria (MEC) Physics that has been determined by Nasrani 1 senior high school Medan of 7,00-7,50 which indicates that level of students' mastery in physics subjects is low.

During this time there is an assumption and impression of most students Senior High School, state that physics is difficult, complicated and requires a higher reasoning in addition to mathematical mastery as a tool in solving problems, so that, students are not interested to learn it. This is a challenge for physics teachers to improve themselves in improving the quality of delivery of subject matter. Because if students are no longer interested in physics lessons coupled with teachers who are not interesting in delivering the subject matter, then do not be expected students will be embedded mastery of good concepts and creativity in solving physics problems.

Static electricity is a part of physics that studies about natural phenomena, especially about the electric field, the type of electrical charge and so on. Most static electricity problems are closely related to the use of Coulomb's Law as well as its solution. But there are also some formulas or laws that can solve the problem of electricity static. Nevertheless there are also many students who face a lot of difficulties about static electricity. According to Dahar (1989) the ability to understand a concept is strongly influenced by the ability of personal's thinking. While the level of mastery expected concept depends on complexity of the concept and level of cognitive development of students. In line with Winkel (1991) interpret the concept of mastery as an understanding by using concepts, rules and principles. While Dahar (1989) defines the mastery of concepts as the ability of students in understanding the meaning of scientific both the theory and its application in daily life. Furthermore Bloom (in Rustaman et al., 2013) states mastery of the concept is an ability to capture such notions as being able to express a material presented into a form that is more comprehensible, able to provide interpretation and able to apply it.

Based on various opinions above can be said that the mastery of the concept is an effort to be done by students in recording and back transfer some information from a particular subject matter, especially the subject matter of static electricity that can be used in problems-solving, analyze, interpret on a particular occurrence. More concisely mastery of concepts is the result of intellectual activity. In addition to students able to master a concept, creativity is also very necessary in problems-solving. According to Semiawan (1990) creativity can be viewed as a process of thinking various ideas in dealing problems. In the process of "playing" with ideas or elements in mind will be fun and challenging for students. In this case creativity is a process of thinking in which students seek to find new correlation, get answers, new methods or ways of problems-solving. In developing the creativity of students are covered by several aspects, namely: cognitive, affective, and psychomotor.

Munandar (1990) states that creativity is "the ability to create new combinations, based on data, information or elements that exist". Besides, it is mentioned that creative personality is obtained by following characteristics: having strong imagination, having initiative, having flexible interest, free thinking, being inquisitive, always wanting to get new experience, self-confidence, full energetic, brave to take risks (not afraid of making this answers to a problem, where the emphasis on quality, quantity, usability and diversity of answers, which has the characteristics of having curiosity, imagination, challenged by pluralism, risk-taking, and respect. Sund (in Slameto, 1995) states the characteristics of individuals who have creative potential are as follows have a desire to know, long-minded, eager to find or research, prefer to perform heavy duties, happy to solve problems, moving and dedicated in doing the job,

flexible, responding quickly or answering questions and having a habit of giving more answers than others, being able in every situations and seek new implications, have an "inquiry spirit," and have a wide reading background.

In the problem-solving the process mainly lies in students, so that students' creativity plays a role in finding answers to problems based on existing data or information. Creative students will be able to create new combinations based on existing data, information or elements, then used as a basis for problem-solving. To solve the problem creatively, the breaking process takes place in five steps: (a) data collection, (b) finding problems, (c) finding ideas, (d) finding answers, (e) finding acceptance. According to Benard and Obourn (in Nur, 1987) problem-solving skills is one of process skills. So that, the science program should develop the various abilities to discover elements in physics and correlation among elements, using laws, formulas, mathematical operations, the using unit systems and understanding the terms.

Based on the description above, it can be said that there is a positive and significant correlation between mastering concept with problem-solving ability. In other words, the physics concepts that are owned or that already exist in the students themselves, will not be mastered properly without the problem-solving or problems related to the subject matter studied. It means, by enhancing the ability to solve problems, students will better master the concepts contained in the cognitive structure and train the ability to think so that it will be able to obtain better learning outcomes. Remembering the importance of creativity in problems-solving, the teacher should use approaches towards students in delivering the subject matter so that can give students the opportunity to develop their creativity. Teachers can do the method by doing demonstrations, observations, giving any tests and assignment in other types which similar to those problems that can challenge students to develop their creativity. The creativity of physics learning especially on the subject matter of static electricity must be delivered with interesting and fun so that students will not feel bored to follow the learning. It will gradually be interested in continuing with the material and they will customary and creative in solving the problems.

Based on the above description, to enhance the creativity of students takes more time and patience to guide them from fundamental to a higher level. Furthermore, guidance should be done continuously and associated with real life, so that students will be interested in solving the intended problem. Thus can be said that between creativity with problem-solving ability has a strong and significant correlation. The physics concepts can be mastered well by the students then a teacher not only provide subject matter in accordance with the outlines of teaching programs in learning, but must be able to create an effective teaching and learning process. The concept of effective teaching and learning will only occur if the students are actively involved in the process of perception of things or problems that provide the stimulus of the lesson. By developing creativity in students themselves it will be able to find and develop their own facts and concepts, as well as problem solving.

Based on the notion of creativity that is the ability to use data or information available to find many possible answers to a problem, where its emphasis on quality, quantity, usability and diversity of answers, then creativity can be viewed in terms of products and in terms of creative process. In terms of creative products, the results obtained can be used to solve problems overcome difficulties, and can bring something better. In terms of the creative process, a creative student is able to reorganize experiences he or she has ever received. These experiences can be concepts, principles, and laws of physics. These experiences are obtained after students have learned and can be easily learned when students solve problems, as scientists discover concepts, laws, and principles.

Leena and Luna International, Chikusei, Japan.
(株) リナアンドルナインターナショナル, 筑西市,日本
ISSN: 2186-845X ISSN: 2186-8441 Print
www.ajmse. leena-luna.co.jp

The ability of a person to master his experiences in the form of concepts, principles, and laws of physics as information ever given to him can be known through the process of learning in the form of mastery of physics concepts. Thus, students who have high creativity is expected to have a good mastery of physics concepts and is directly related to the ability of students in solving problems. In this study there are three variables that are considered to be interconnected between mastery of concepts with problem-solving ability, between creativity with problem-solving ability and between mastery of physics concepts and creativity simultaneously with problem-solving ability.

OBJECTIVES OF RESEARCH

This research aims to determine the correlation between the mastery of physics concept with problem solving ability, creativity with problem-solving ability, mastery of physics concepts and creativity simultaneously with problem-solving ability on the material of static electricity for grade XII natural sciences students of Nasrani 1 senior high school Medan.

STATEMENT OF PROBLEM

The problem of this research is to investigate the correlation of mastery of physics concepts with problem-solving ability, creativity with problem-solving ability, and mastery of physics concepts and creativity simultaneously with problem-solving ability on the material of static electricity for grade XII natural science students of Nasrani 1 senior high school Medan.

RESEARCH METHODS

The research took place in Nasrani 1 for grade XII senior high school Medan in the academic year 2015/2016 with the type of correlation research. The research variables are mastery of physics concepts (X_1) and creativity (X_2) which is called as independent variable. The dependent variable is problem-solving ability (Y).

Research Hypotheses

The following hypotheses were raised to guide the investigation:

1. There is no the correlation of mastery of physics concepts with problem-solving ability
2. There is no the correlation of creativity with problem-solving ability
3. There is no the correlation of mastery of physics concepts and creativity simultaneously with problem-solving ability

Population and Sample

Population in this research was all students for grade XII senior high school of Nasrani 1 Medan and sample was student of grade XII natural science counted 25 people whose taking is done by purposive sampling technique.

Instrumentation

The research instrument used to collect research data includes physics concepts test as much as 20 items which arrangement based on learning objectives on the materials of coulomb force, electric potential, electric field and capacitors energy and capacitor circuit. Before the concept master test instrument is piloted**,** scoring is done first, giving the number one (1) for the perfect correct answer and the zero (0) for the wrong answer. This item analysis is useful to determine the validity and reliability coefficients of the concept master test. The raw score

is converted to a standard score using the Arikunto formula (2001: N = $\frac{a}{b}$xc; with: N = raw value, a = acquisition score, b = maximum score and c = weight.

Creativity Questionnaire are 27 items test with 5 alternative answer option and references to Likert Scales as : 1) Strongly Agree (SA), 2) Agree (A), 3) Undecided (U), 4) Disagree (D) 5) Strongly Disagree (SD). Development of this creativity questionnaire is done by researchers based on creativity indicators. In this research formulation of statement is done in two form that is positive statement (favorable) with weight of 0, 1, 2, 3 and 4 and statement of negative (unfavorable) with weight of 4, 3, 2, 1, and 0. While test of mastery of problem-solving of as much as 20 items in the form of subjective tests, arranged in accordance with the subject matter of static electricity. In accordance with the purpose of the test is to measure the ability of students in solving problems, then the items made are emphasized in the classification of applications, analysis and synthesis. But the classification of knowledge and understanding is also used before it comes to solving the problem. Rule of assessment is given as follows: If the question is answered properly and true the value is one, then if the question is answered correctly but not perfect half the value, and if the problem is answered but wrong or the problem is not answered then the value is zero. The formula for converting raw scores into standard scores is also the same as using the formula on the concept master test.

ANALYSIS OF DATA

The data was analyzed using SPSS 18.0 software package at 0,05 significant level (α) .

Pilot Testing of Instrument

The both coefficient of validity and reliability of the three instruments was determined by pilot testing to Methodist 1 for grade XII senior high school Medan students as many as 26 people. According to Wijaya (2000) validity test is determined by finding Pearson product moment correlation coefficient. The requirement of a test item is valid if $r_{xY} > r_{table}$ and sig value (p_{value}) < 0,05 then item valid, and instrument reliability coefficient used is Split-Half Gutmann coefficient technique (split technique) because the scoring score is 1 and 0 with the condition of an instrument is said to be reliable if $r_{XY} > r_{table}$. While for questionnaire creativity and problem solving test is used Cronbach Alpha technique formula because the scoring score is 0,0; 0,5; 1,0; 2,0; 3,0 and 4,0. According to Ghozali (2001) if the value of Cronbach Alpa > 0.60 then the questions to measure the observed variable "reliable" and if the value of Cronbach Alpa < 0.60 then the questions to measure the variable observed "not reliable".

Based on the analysis results obtained coefficient validity and reliability of each instrument presented in Table 1.

Table 1. Summary of Validity and Instrument Reliability Coefficients

Instrument	*Coefficient*		r_{table} Value	*Information*
	Validity	*Reliability*		
Physics Concept Mastery Test	0,776 (average)	0,961	$r_{(23)(0,05)} = 0,413$	valid and reliable
Creativity Questionnaire	0,716 (average)	0,759	$r_{(26)(0,05)} = 0,388$	
Problem-Solving Ability Test	0,583 (average)	0.733	$r_{(22)(0,05)} = 0,423$	

Leena and Luna International, Chikusei, Japan.
(株) リナアンドルナインターナショナル, 筑西市,日本
ISSN: 2186-845X ISSN: 2186-8441 Print
www.ajmse. leena-luna.co.jp

Based on Table 1 it appears that all instruments are valid and reliable. Furthermore, the mean value and standard deviation of conceptual research data of Mastery of Physics Concepts (MPC) and Creativity (Cr) are moderate, while problem-solving ability (PSA) is good. The result of normality test to the three result data obtained by sig.(p_{value}) > 0.05 which means that the sample is from a normally distributed population.

Testing of Normality

Prior to hypothesis testing, the value data mastery of physics concepts, questionnaire creativity and problem-solving ability tested normality by using Kolmogorov-Smirnov test. According to Bama (2013) the steps of analyzing the data normality test with SPSS software package are as follows: 1) establish H_o and H_a as follows, H_o:The sample comes from normally distributed population and Ha: Sample does not come from normally distributed population , 2) set the level of significance (α) = 0.05, 3) compare sig. (p_{value}) with α = 0.05, 4) if sig.(p_{value}) > α = 0.05, then the sample is from a normally distributed population, on the contrary if sig. (p_{value}) < α = 0.05, then the sample did not come from a normally distributed population. The result of normality test to the three result data obtained by sig.(p_{value}) > 0.05 which means that the sample is from a normally distributed population. The summarizes of the results of these three variables are presented in Table 2.

Table 2. Mean value, Standard deviation and Normality Test of Research Sample

One-Sample Kolmogorov-Smirnov Test				
		PCM	*Cr*	*PSA*
N		25	25	25
Normal Parameters[a,b]	Mean	74.0000	70.8000	78.8000
	Std. Deviation	5.20416	9.14239	6.65833
Most Extreme Differences	Absolute	.216	.203	.268
	Positive	.184	.203	.268
	Negative	-.216	-.149	-.164
Kolmogorov-Smirnov Z		1.081	1.016	1.342
Asymp. Sig. (2-tailed)		.193	.253	.054

Testing of Multicollinearity

Multicollinearity test is useful to see whether the independent variable multicollinearity symptoms occur with other variables. According to Chalil (2008) if the value of Variance Inflation Factor (VIF) greater than 2 usually has occurred multicollinearity problems. The linearity test of the independent variable with the dependent variable is aimed to find out the correlation linearity. For that purpose, the researcher did a linear test of the possible regression lines. According to Bambang (2013) the steps of regression analysis with SPSS software package are as follows, 1) test the data normality of each variable (especially the dependent variable), use Kolmogorov Smirnov test, 2) calculate the values of the regression coefficient, so the regression equation Y = a + bX. 3) Test the significance of regression equation with ANOVA test with criterion, if $F_{calculated} > F_{table}$, then the regression equation means at α is selected. If otherwise does not mean or if sig. (p_{value}) < α, then the regression equation means, on the contrary the regression equation is meaningless and 4) The significance test of the regression by the criterion, if $t_{calculated} > t_{table}$, then the regression coefficient means at α is selected. If the reverse coefficient of regression is meaningless or if

otherwise sig. (p_{value}) < α then the regression coefficient is meaningless. By multicollinearity test obtained the same VIP value for both independent variables that is 1,490 which indicates the absence of symptoms of multicollinearity. The summary of the multicollinearity coefficients of the two independent variables is presented in Table 3.

Table 3. Coefficient Values of Variable Multicolonierity Test Variable

Coefficients[a]								
Model		*Unstandardized Coefficients*		*Standardized Coefficients*	*t*	*Sig.*	*Collinearity Statistics*	
		B	*Std. Error*	*Beta*			*Tolerance*	*VIF*
1	(Constant)	6.487	10.851		.598	.556		
	MPC	.694	.178	.542	3.886	.001	.671	1.490
	Cr	.296	.102	.407	2.918	.008	.671	1.490

A. Dependent Variable: PSA
MPC: Mastery of Physics Concepts
Cr: Creativity

Testing of Hypotheses

Based on the data analysis, the values of constants (b), t and sig. and presented in Table 4. From Table 4, the third H_o was rejected otherwise H_a was accepted, it means there are strength of positive correlations which is significant between mastery of physics concepts with problem-solving ability, creativity with problem-solving ability, and mastery of physics concepts and creativity simultaneously with problem-solving ability on the subject of statics electricity for grade XII natural science of senior high school of Nasrani 1 Medan. Furthermore the results of the correlation coefficient analysis are shown in Table 5.

Table 4. Significance Test of Research Hypotheses

Hypothesis	*Regresion Equation*	*t*	*Sig.*	*H_0*
1	$Y=5{,}369+0{,}992X_1$	5,893	0,000	Reject
2	$Y=41{,}77+0{,}523X_2$	4,497	0,000	Reject
3	$Y=6{,}487+0{,}694X_1+0{,}296X_2$	3,886	0,000	Reject
		2,918	0,008	Reject

Table 5. Correlation Coefficient

Variabel	*R*	*R_{Square}*	*Adjusted R Square*	*Std Error of Estimate*
X_1, Y	0,776	0,602	0,584	4,29338
X_2, Y	0,763	0,582	0,559	6,49087
(X_1, X_2),Y	0,844	0,713	0,687	3,72741

From Table 5 it can be seen that correlation coefficient, the contribution between mastery of physics concepts with problem-solving ability and between creativity with problem-solving abilities are 0,776 and 0,763 be medium-classified ; and contribution 60,2% and 58,2%, respectively; and between mastery of physics concepts and creativity simultaneously with problem-solving ability is 0,844 (71.3%) be strong-classified. While Adjusted R_{Square} value

Leena and Luna International, Chikusei, Japan.
(株) リナアンドルナインターナショナル, 筑西市,日本
ISSN: 2186-845X ISSN: 2186-8441 Print
www.ajmse. leena-luna.co.jp

which explains the ability of the research sample is high accuracy in finding the required answers from its population are 0,584 (58,4%); 0,559 (55,9%); and 0,687 (68,7%). Analysis of Variance (ANOVA) is useful to see whether linear or not variance is presented in Table 6. Table 6 shows that the sig.(p_{value}) < 0.05 which states that each correlation of both variables is linear.

Table 6. Summary of ANOVA

Predictor	*Model*	*Sum of Square*	*df*	*Mean Square*	*F*	*Sig.*
Mastery of Physics Concepts	Regression	640.038	1	640.038	34.722	.000[a]
	Residual	423.962	23	18.433		
	Total	1064.000	24			
Creativity	Regression	548.555	1	548.555	24.477	.000[a]
	Residual	515.445	23	22.411		
	Total	1064.000	24			
Mastery of Physics Concepts and Creativity	Regression	758.342	2	379.171	27.291	.000[a]
	Residual	305.658	22	13.894		
	Total	1064.000	24			

CONCLUSIONS AND SUGGESTIONS

Based on hypothesis testing and analysis of research data and interpretation of research results, then in this research can be drawn conclusions as follows: (1) the average value of mastery of physics concepts is 74,0 with standard deviation 5,20, creativity 70,8 with standard deviation 9,14 and problem-solving ability 78,8 with standard deviation 6,66. (2) there was strength of positive and significant correlations between mastery of physics concepts with problems-solving ability on the material of static electricity for grade XII natural science students of Nasrani 1 senior high school Medan, where obtained correlation coefficient of 0,776 and linear regression line equation $Y = 5.369 + 0.992\ X_1$ with contribution amounted to 60,2%. (3) there were strength of positive which is significant between creativity with problem-solving ability on the material of static electricity for grade XII natural science students Nasrani 1 senior high school Medan, where obtained correlation coefficient is 0,763 and linear regression line equation $Y = 41,77 + 0,523X_2$ with contribution amounted to 58,2% (4) there were strength of positive correlations which is significant between mastery of physics concepts and creativity simultaneously with problems-solving ability on the material of static electricity for grade XII natural science students of Nasrani 1 senior high school Medan, where obtained correlation coefficient is 0,844 and equation of multiple linear regression $Y = 6,487 + 0.694\ X1 + 0.296\ X_2$ with a contribution amounted to 71.32%.

Based on the findings of the research and conclusion reached, the following suggestion were made: 1. in order to students learning outcomes for physics could give the optimal results, especially through the enhancing mastery of concepts, students'creativity and problem-solving ability on material of static electricity, 2. physics teachers are encouraged to motivate their students more actively in learning, and always seek to enhance problem-solving ability by training students' skills to solve of physics problems which at the same time can stimulate students to think actively and creatively.

REFERENCES

[1] Arikunto, S. (2001). *The basics of evaluation of education*. Jakarta: Bina Aksara.

[2] Bama. (2013). *Test of normality with SPSS (online)*. Retrieved from http://normalitasicebender.blogspot.com.

[3] Bambang. (2014). *Regression analysis SPPS 15*. Retrieved from upiedu/Directory/FPMIPA/Jur. Pend.

[4] Chalil, D. (2008). *Correlation and regression analysis in SPSS 15*. Medan: Author.

[5] Dahar, R.W. (1989). *Theories of learning*. Jakarta: Erlangga.

[6] Ghozali, I. (2001). *Application of multivariate analysis SPSS*. Jakarta: UNDIP.

[7] Jerrold, E., Morrison, G., & Ross, S.M. (1994). *Designing effective instruction*. New York: Macmillan College Publishing Company.

[8] Mulyasa. (2006). *Education unit level curriculum*. Bandung: Remaja Rosda Karya.

[9] Munandar, S.C.U. (1987). *Develop the talent and creativity of school children.* Jakarta: Gramedia.

[10] Nasrani 1, S.M.A. (2016). *Print out a list of the value of national examination (NE)*. Medan: Medan Years Lessons.

[11] Nur, M. (1987). *Approach of process skills in science education, as a process of skills approach in vocational education.* Surabaya: PKP Papers in FPTK IKIP.

[12] Semiawan, C. (1990). *Nurture talent and creativity of high school students*. Jakarta: Gramedia.

[13] Slameto. (1995). *Study and the factors that affected it*. Jakarta: Rineka Cipta.

[14] Sunardi. (2010). *Bilingual physics for High School/MA Class XII Semester 1 and 2*. Bandung: YramaWidya.

[15] Winkel, W.S. (1991). *Psychology of teaching*. Jakarta: PT Grafindo.

Leena and Luna International, Chikusei, Japan.
(株) リナアンドルナインターナショナル, 筑西市,日本
ISSN: 2186-845X ISSN: 2186-8441 Print
www.ajmse. leena-luna.co.jp