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Influence of Project-Based Learning Model that Aided Matrix Laboratory toward Creative Thinking Skills Viewed from College Student's Science Generic Skills

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ABSTRACT

This study aimed at anlyzing the influence of project-based learning that aided matrix laboratory toward college student's creative thinking skills and the influence of science generic skills toward the relationship between project -based learning model that aided matrix laboratory and college student's creative thinking skills. The method used in this research was pre-experiment method with design is one shot case study. Data analyzed by regression test with moderating variable. The Results of the analysis found that (1) there is the influence of project based learning model that aided matrix laboratory toward college student's creative thinking skills (44.3%); (2) there is the influence of science generic skills to the relationship between project-based learning model that aided matrix laboratory and college student's creative thinking skills (28.6%). The science generic skills had been contributed to strengthen the relationship between project-based learning model that aided matrix laboratory and college students's creative thinking skills.

Keywords: college students's creative thinking skills, matrix laboratory, project-based learning model

INTRODUCTION

Orientation of the education should be relevant to demand of 21st century, that their characteristics were information, computation, automation, and communication (Saha & Mukherjee, 2003). So that, education should not only orientate to improve the college student's knowledge but also grow up the creative thinking and critical thinking (Wals & Jicling, 2002; Pithers & Soden, 2002). College students use creative thinking skills to make reasons effectively, think systematically, solve the problem, and make consideration and decision. Other than that, skills focus of 21st century are skills to use technology and communication media, that are capabilities to use media as resource of learning and tools to solve the problem, communicate, work, and creativity. Capability to use technology and communication include capability to access the information effectively, able to use and criticize the information, able to use information as a tool to research, communicate, and evaluate (Bawden, 2001; Livingstone, 2004).

The impact of technology in transforming education and how to people teach and learn are huge. Previous impact can actually lead to meaningful learning and whether traits such as creativity can be enhanced through the MATLAB application (Balamuralithara & Woods, 2009; Wheeler, Waite & Bromfield, 2002). Computer technology can be employed to transform texts and graphics, manipulate colors and audio and use other computer effects to create dynamic and animated representations of information (Kassim, 2013)

In order to attain the competency of creative thinking through technology and communication media then student should be facilitated by the learning model that combination between problem solving and application based on technology and communication (Earle, 2002). Student

works the project- based problem that solved by application called matrix laboratory (MATLAB). Through this task, students are expected to be able to solve and visualize the abstract problem in the project into concrete and communicative solutions. If the student is able to visualize the solution of an abstract problem then easily understood the physical meaning of the problem (Duval, 1999). One of the problems that are difficult to understand its physical meaning is the wave equation, especially wave differential equation.

Using the MATLAB to solve the abstract physical meaning problem in project based learning can aid the students to understand and interpret the meaning of equation in the form of graph (Gan, 2002; Blomhøj & Jensen, 2003). Based on this interpret, student able to explore their creative thinking to solve this problem. Creative thinking of students that are ability to trigger many answers in solving problems (fluency), ability to provide various ways in solving problems (flexibility), able to create different combinations to express answers (originality), able to find a deeper meaning to troubleshooting by using detailed steps (elaboration) (Sternberg, & Lubart, 1999; Awang & Ramly, 2008). In addition to triggering students' creative thinking skills, MATLAB can develop thinking skills to connect between theory and experimental results through the ability to think using logic. Puerto (2012) said that the ability of learners to simulate theories in MATLAB can improve the understanding of physics, explore the limitations of theory, and can relate between theory and experiment. The existence of physics computational courses in the physics education program at the State Islamic Institute of Palangkaraya has not yet applied the MATLAB application. Meanwhile, it course is computer programming. The programming language used is Pascal language and C++ language. Implementing MATLAB language to solve wave optic problem is needed. Student's ability to construct the MATLAB script is determined by science generic skills. Through science generic skills help the students to improve their logical thinking so that they able to make various answers from a problem.

METHOD

The method was used on this research is pre-experimental with one shot case study (Gay, *et al*: 2012). Sample was chosen by cluster simple random sampling. Student's creative thinking and science generic skill were gathered by essay test. Student's ability to following the project-based learning was gathered by product assessment. Data are analyzed by regression test with moderating variable.

RESULTS AND DISCUSSION

Before hypotheses tested, the normality and linier of data were tested. Normality of data was tested with Kolmogorov-Smirnov test and linier of data was tested with Ramsey test.

a. Normality test

Table 1. One-Sample Kolmogorov-Smirnov Test

		KBK	PjBL	GS
N		11	11	11
Normal Parameters[a]	Mean	66.4545	64.5455	46.2727
	Std. Deviation	1.07458 E1	9.60587	1.37775E1
Most Extreme Differences	Absolute	.175	.227	.186
	Positive	.122	.227	.123
	Negative	-.175	-.160	-.186
Kolmogorov-Smirnov Z		.580	.754	.618
Asymp. Sig. (2-tailed)		.890	.620	.840

a.Test distribution is Normal.

Table 2. Decision of normality test

No	Data	Kriteria	Decision
1	KBK	0, 890 > 0,05	Normal
2	PjBl	0,620 > 0,05	Normal
3	GS	0,840 > 0,05	Normal

b. Linier test

Table 3. Model Summary[1]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.806[a]	.649	.561	7.11920

a. Predictors: (Constant), GS, PjBL

b. Dependent Variable: KBK

Table 4. Model Summary[2]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.972[a]	.944	.920	3.04393

a. Predictors: (Constant), DFFIT, PjBL, GS

b. Dependent Variable: KBK

$F_{count} = 21,07$ and $F_{table\,(3,9)} = 8,8$. Because of $F_{count} > F_{table}$ then H_O was rejected, so data is non linier.

In this research two hypotheses was tested, they are H_{01}: there is no influence of project-based learning that aided matrix laboratory toward student's creative thinking, H_{01}: there is no influence of science generic skills toward the relationship between project based learning model that aided matrix laboratory and student's creative thinking. Regression test result on Table 1 show that sig. (0,025) < 0,05 then null hypothesis rejected, so that there was influence of project-based learning that aided matrix laboratory toward student's creative thinking.

Table 5. Result of H_{01} tested

Model	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	T	Sig.
(Constant)	18.37	18.13		1.01	.33
PJBL	.745	.278	.666	2.67	.02

a. Dependent variable: student's creative thinking
b. Independent variable: project based learning (PJBL)

The regression equation have gained is $Y = 18,379 + 0,745X + e$. Base on this equation, we know that the regression coefficient is 0,745. Thereby, the influence of project-based learning that aimed by matrix laboratory to the student's creative thinking was 0,745. That mean is while value of student's project-based learning enhance one unit then student's creative thinking will be reach to 0,745 units. Influence great of project-based learning model can be found by determination of regression coefficient (R) that is $R = B^2 = (0,745)^2 = 43\%$, so that student's creative thinking was influenced by project-based learning model that aimed by matrix laboratory as big as 43%.

Project-based learning model that aimed by matrix laboratory could be influenced the student's creative thinking because of its syntax is open-ended that could be facilitated the students to solve the project in various ways. Besides that, students were facilitated to use their knowledge to create authentic product as a learning outcome. This model is convenient way to develop basic skill should be attain by students, include ability to make decision, creativity, solving the problem, and enhancing the confidence of students. In the project-based learning, by solving different problems it is possible to develop creative ideas while improving highly developed skills (Sart, 2014).

According to Abidin (2013), project-based learning will be giving instructional effects they are (1) enhance ability of students to comprehend the lesson, (2) develop the student's ability to think critically, creatively, and innovatively, (3) develop product creativity of students. Meanwhile the side effect of instructional this model are (1) develop the character of students such as discipline, precise, work hard, responsibility, tolerant, attitude, courageous, critical, as well as ethical, (2) create the own life skill of students, (3) enhance the scientific attitude of students, (4) develop student's ability to communicate, argument, and collaborate. Relate to the strength of project based learning to enhance the comprehend the lesson was researched by Rauduvaite (2015) show that "the contribution of project-based learning to (self) development of learners' general and subject competencies has been widely acknowledged". Problem-based learning, visual programming and project are technologies that can potentially help leaner to perform better in the introduction programming course, in turn effect their performance in project (Topalli and Cagiltay, 2018). Through this model,

students can explore their ability to think creatively and logically to solve the project. They are using various ways to solve the problem, collecting the variation of answer alternative, creating the combination to gain the different answer, and provide the detailed answer. Result of Mellor research (2010) show that "the students use MATLAB in many creative ways to control experiments, as well as to model and analyze data". The simulation results are compared with experiment results and good agreement is obtained (Xue, 2016). Efstratia (2014) said that core idea of Project Based Learningis to connect student's experiences with school life and to provoke serious thinking as students acquire new knowledge. That occur because of MATLAB is application that use higher language program to compute the numerical, visualize, and create the program. Sanjaya (2013) said that MATLAB is application to analyze and visualize the data Because of the coherence of MATLAB to facilitate the students to develop their creative thinking through project based learning model. MATLAB able to integrate computation, visualization, and programming, so that this application can be used to modeling, simulation, data analysis, visualization. Based on this worthwhile of MATLAB, the students enable to do their project feasible and think creative to modify their ways to provide the answers. For only a fart of generated equation of wave into mathematical expressions can be expressed by curve and generate useful shapes. Students do the project using the MATLAB application through fit a mathematical expression to curve the wave equation, edit the equation and adjust the equation coefficients to improve their ability to provide a various answers.

Contribution of project based learning that aided by MATLAB can be occurred because it is has several superiority that are (1) encouraging and habituating the students to make inquiries, investigate, apply planning skills, use critical thinking, and apply problem solving skills to solve the project; (2) encouraging the students to apply their knowledge, skills, and attitude in a variety of concepts to solve the project; (3) giving a opportunity to the students to apply their interpersonal skills and collaborate on team work in real experience (Mioduser & Betzer, 2008; Bell, 2010; Kemendikbud, 2015).

Regression test result on Table 2 show that sig. (0,021) < 0,05 then null hypothesis rejected, so that there was the influence of science generic skills toward the relationship between project based learning model that aided matrix laboratory and student's creative thinking. In the other hand, there was influence of project-based learning model that aided matrix laboratory and science generic skills simultaneously toward student's creative thinking, their influence are 72,9%.

Table 6. Result of H_{02} tested

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	842.26	3	280.756	6.29	.021[a]
Residual	312.46	7	44.637		
Total	1154.72	10			

a. Predictors: (Constant), X1X2, PJBL, science generic skills

b. Dependent Variable: student's creative thinking

Table 7. Determination coefficient of moderating variable

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.854[a]	.729	.613	6.68111

a. Predictors: (Constant), X1X2, PJBL, GS

First determination coefficient without moderating variable was found 44,3%, meanwhile, second determination coefficient wit moderating variable was found 72,9%. Because of enhancing the determination coefficient that is 28,6%. Thereby, existence of moderating variable (science generic skills) able to strengthen the relationship between project-based learning model that aided matrix laboratory and college student's creative thinking.

Implication this result is the ability of students to make the solving problem script on MATLAB defend on their science generic skills. If the students have good

basic science generic skills then they can make solving problem script easily and precisely. Science generic skills influence to ability students to solve wave equation problem with MATLAB because it is related to ability students to direct observation, indirect observation, awareness to scale, symbolic language, logical frame, logical inference, cause-effect law, mathematics modeling, constructing concept, abstracting the phenomena. In this case especially they able to abstract the problem to concrete problem, so the problem can observe in graph form then easily to interpret what meaning physics is. Using logical frame the students can make relation among the parameters of wave equations, so that, the students can manipulate a various answers probability. Generic algorithm, mathematical expression tree, and visualization are able to generate some creative solutions and demonstrate the potential of computational approach in creative design (Liu, *et al*, 2004).

CONCLUSION

The Conclusion of this research are 1) there is the influence of project-based learning that aided matrix laboratory toward creative thinking, that is 44,3%, 2) there is the influence of science generic skill toward the relationship between project-based learning model that aided matrix laboratory and student's creative thinking, that is 28,6%. Meanwhile, science generic skills strengthen the relationship between project-based learning model that aided matrix laboratory and student's creative thinking.

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