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Analysis of 21st Century Skills of Student on Implementation Project Based Learning and Problem Posing Models in Science Learning

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Abstract

The purpose of this study was to distinguish the analyze the difference 21st-century skills of student between the PjBL and the Problem Posing learning models. This research is a quasi-experimental study. Determination of subjects was performed purposively on fourth-grade students of Randuagung Elementary School as the 1st experimental class, amounting to 35 students, and Sukorejo Elementary School as the 2nd experimental group, amounting to 32 students. Data collection was performed by observing communication and collaboration skills during the learning and providing tests of critical thinking and creativity skills after implementing the models. Data analysis used MANOVA. The results showed that there were significant differences in 21st-century skills between students implemented using the PjBL and the Problem Posing models. The optimal PjBL model implementation is creativity, communication, and collaboration skills, due to the results of the multivariate test are different and have a higher average if compared with the implementation of the Problem Posing model. Whereas the implementation of the Problem Posing model has not been optimal for all skills. Critical thinking skills achieved by a student in both model implementation have no significant difference. The differences in the average of the 21st-century skills gained by the student in the two models do not differ greatly. However, the intensity result is that from four skills on the Problem Posing model, critical thinking skills is improve significantly.

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INTRODUCTION

Sophisticated technology development places every individual to meet complex challenges. It also happens regarding education, where the ability of students is also developed according to the current development. In Ontario Public Service (2016), today students are not required to master skills and knowledge merely, but more on competencies that put forward the application of results they have learned. The Competencies have a broader scope, where the elements considered are cognitive, functional skills, interpersonal skills, and ethics. These are then referred to as 21st-century skills that cover all the competencies needed in dealing with changing environments, complex challenges, and skills used in everyday life (Acedo, and Hughes, 2014). Therefore, learning that is by the development of competencies and requires skills needs to be identified in order to overcome current challenges (Scott, 2015).

There are several types of competencies to fulfill 21st-century skills, including critical thinking, creativity, collaboration, and communication skills, which referred to as 4C. Critical thinking skills are deep thinking skills from different perspectives so that useful solutions are obtained. Creative skills generate ideas, new ways of looking at a problem and real actions to do new things that are useful to the surroundings, while communication skills are their efforts in conveying things to others (related to language). Collaboration is the way they perform in teams. The 21st-century skills were chosen as the embodiment of those who were able to adapt to changes in the environment. This is by science learning, and the 2013 curriculum carried out in schools that put forward skills and competencies in the era of globalization.

Science or better known as *Ilmu Pengetahuan Alam* (*IPA*) in *Bahasa* has a central role in shaping people who are aware of current development. Trnova, and Trna (2015) said that the need for science learning early on, i.e., at the elementary school level by providing an understanding of concepts and activating students through meaningful activities such as observing, experimenting, trying, or producing products to provide experience. In order to develop properly, science learning must refer to students and encourage teachers to be more creative in designing learning. Integrative science through application and development of thinking, responsibility, and caring for nature is a form of learning needed for science learning today (Wiyanto, and Widiyatmoko, 2016). Science learning in the 2013 curriculum according to Prihantini (2018) is by developing inquiry-based learning and. Problem solving-based learning with making a contextual product (project-based learning). It aims to provide students in doing activities such as to explore, create, and learn deeply about the environment.

There are various kinds of learning models to achieve 21st-century skills. The existence of learning models namely Project Based Learning (PjBL) is one of the learning models where students make a product as a result of a series of learning processes so that they are independent and sensitive with an object around. Research of PjBL model in science learning at schools has been carried out with good results. Arisanti, Sopandi, and Widodo (2016) found that the PjBL model in science learning improves the quality of learning in the form of concepts-understanding. That study also observes the students' ability to think creatively with the results of a less significant increase. The highest increase in thinking occurs in aspects of fluency. In line with these results, Sumarni, Wardani, Sudarmin, and Gupitasari (2016) reveal that the model improves students' psychomotor skills. All psychomotor aspects are assessed including readiness, transition response, proficiency, adaptation, and creation in the high category. Ismuwardani, Nuryatin, and Doyin (2019) revealed that PjBL implementation in learning could improve student creativity. The improvement is seen from the average N-gain score of 0.43 (medium category). Indicators of creativity that described in the research include fluency, flexibility, and originality. Wicaksana, Wardono, and Ridlo (2017) in their research showed that PjBL with the help of Schoology (social networking) was able to increase curiosity. Capabilities that gain

influence from the increase in curiosity character include communicating, mathematizing, representation, reasoning, using symbolic formal and technical operation and using mathematics tools.

In addition to the PjBL model, there is also Problem Posing where which focuses on students' ability to raise problems. Thobroni, and Mustofa (2012) revealed that the Problem Posing model develops students ability to understand problems critically and their environment. The model is prioritizing teacher to learn from students and students to learn from teachers, both of which have positive reciprocal relationships. Satriawati (2017) in her research stated that the Problem Posing model shows a positive influence on the learning outcomes of elementary school class V students. The cognitive abilities of students in science learning have increased when compared to conventional learning. The same result was expressed by Triani, Wibowo, and Fadhilah (2017) who say that Problem Posing learning affects learning effectiveness. Students' learning outcomes increase because during the learning process the prerequisite materials are given and students directly make their questions, so it helps students understand the problematic learning materials.

By implementing he PjBL and Problem Posing models, students are expected to improve 21st-century skills well. Bickham, Bradburn, Edwards, Fallon, Luke, Mossman, and Ness (2008) argue that if students try to complete tasks in their way, i.e., new way and creative, group and social-oriented, do not hesitate to share what they have learned and got, and tend to take risks from what they decide, then they have succeeded and ready to face global challenges.

However, science learning has potential obstacles when applied. The teaching-learning process performed by teachers is more knowledge-oriented so students lose experience that will prepare them for a more fulfilling life and more productive work. The traditional memorizing approach applied by teachers has not been able to advance students' thinking abilities (Scott, 2015; Sholihah, and Rusilowati, 2017). Another thing that causes difficulties in implementing the models is that the implementation of learning cannot be quickly followed by students where they are asked to take responsibility for the learning process by setting goals, monitoring, reflection, and supports from beginning to end (English, and Kitsantas, 2013). The supporting components of the learning models have also not been adequately met, such as guidelines and equipment that may be used. Agustami, Wiyanto, and Alimah (2017) in their research show that according to the perception of teachers the application of science learning has not yet received adequate support, including teaching materials that are not fully integrated, teachers who have not mastered the material, and limited-time. Cintang, Setyowati, and Handayani (2017) mention that teachers can develop learning, but lack of infrastructure facilities by the materials have made them not to implement it to the fullest.

This condition is also in line with what had experienced by elementary school students in Sumber, Rembang. Based on the results of observations and interviews in several elementary schools, data obtained showed that teachers had not developed science learning in the 2013 curriculum well. Teachers use teacher-and-student-books during the learning process assisted by LKS (student worksheet) and internet. Teachers in finding learning resources have not empowered students. Teachers have implemented learning methods by using lectures, discussions, and assignments, but they still have difficulties in classifying students, and the methods are less effective because students are noisy and less responsible for their duties. The ability of students to engage in learning is still low both in groups and individuals. Students have not been able to provide a simple explanation of the material that has been delivered and has difficulties when concluding learning. Teachers have asked students to create a work, but the work is often in the form of a report. This certainly does not sharpen students' creativity in developing ideas. For this reason, in overcoming learning problems, the synergy between teacher-students, students-students, students-parents, teachers-parents is needed so that relationships

and cooperation will be assured to improve the quality of learning.

Based on the explanation of these problems, it is necessary to examine and study the PjBL and Problem Posing models that are appropriate for developing 21st-century skills in science learning. The appropriate learning to be used is the learning displays these skills in planning, process, and results.

METHODS

This study used a quantitative approach, namely quasi-experiment, aimed at analyzing 21st-century skills differences in the PjBL and Problem Posing models. The subjects of this study were the fourth-grade students of Randuagung Elementary School as experimental group 1 and SD Sukorejo as experimental group 2. The independent variable was the learning models consisting of the PjBL and Problem Posing models. Dependent variables were critical thinking, creativity, communication, and collaboration skills. The treatment instruments in this study were a syllabus, lesson plan, teaching materials. The learning material used was theme 2: Always Save Energy.

Learning activities in both classes were almost the same. The difference was only in the learning models, the experimental class 1 used PjBL with the process of making flipcharts related to learning material, while the experimental class 2 used the Problem Posing model using group-work working on group worksheets in the form of making questions and answers together with the task of making mind mapping structured. The learning steps of the PjBL according to Rusman (2014), including starting with the essential questions, designing a plan for the project, monitoring the students and the progress of the project, assessing the outcome, evaluating the experience. Flipcharts made by students were visual media such as the frame of mind, diagrams, charts, or graphics arranged using wide cartons that can be opened and flipped, and if necessary can be shown again later (Susilana, and Riyana, 2009). The Problem Posing learning model was applied through learning steps, including explanation of the subject matter and tools used in learning, giving sufficient practice questions, challenging questions submitted by students and can be solved in groups, the teacher asked students to present the findings, and the assignment of individual homework, in the last step student make mind mapping structured.

Data analysis using prerequisite analysis, and hypothesis tests. The data normality test on critical thinking skills, creativity, communication, and collaboration was tested using the Kolmogorov-Smirnov test. The variance homogeneity test was assessed using Leven's test of equality error variance. Hypothesis analysis of the value of critical thinking skills, creativity, communication, and collaboration using Multivariate Analysis of Variance (Manova) with a significance level of 5%.

RESULTS AND DISCUSSION

The results of the normality test for 21st-century skills using Kolmogorov-Smirnov showed the results of the four 21st century skills with a normal distribution. The significance value of critical thinking skills was 0.699; significance value of creativity skills was 0.302; significance value of the collaboration skills was 0.715, and the significance value of the collaboration skills was 0.483. All those significance values are higher than 0.05. The homogeneity test results showed that the significance of each critical thinking skill was more than 0.05. The significance value of critical thinking skills was 0.232; significance value of creativity was 0.280; significance value of communication skills was 0.136; significance value of collaboration skills was 0.41, also higher than 0.05. These results indicated that there were variance similarities in the 21st-century skills in the class categories were fulfilled.

The first hypothesis test carried out using Multivariate Analyze of Variance (MANOVA) with the help of SPSS 16.00 for windows where the hypothesis testing in this study used multivariate tests by Pillai's Trace, Wilks' Lambda, Hotelling's Trace, Roy's Largest Root tests. From the results of the hypothesis tests

performed, the value of F = 7.379 with a significance level of 0.000 was obtained, since this significance level was lower than 0.05, so H_0 was rejected, and H_1 was accepted stating that there are differences in 21st century skills, between students implemented by PjBL learning model and students implemented by the Problem Posing learning model. A summary of the of the multivariate test results by using the Pillai's Trace, Wilks' Lambda, Hotelling's Trace, Roy's Largest Root tests are shown in Table 1.

Table 1. The Results of Multivariate Test

	Effect	Value	F	Hypothesis df	Error df	Sig.	Noncent. parameter	Observed power[b]
Class	Pillai's trace	.323	7.379[a]	4.000	62.000	.000	29.515	.994
	Wilks' lambda	.677	7.379[a]	4.000	62.000	.000	29.515	.994
	Hotelling's trace	.476	7.379[a]	4.000	62.000	.000	29.515	.994
	Roy's largest root	.476	7.379[a]	4.000	62.000	.000	29.515	.994

The results of the second hypothesis, carried out using F_{value} analysis on critical thinking skills model of the between-subject effect test. Based on Table 2, F_{value} of 0.001 is obtained with a significance level of critical thinking skills of 0.973, greater than 0.05. Thus H_0 is accepted, stating that there is no difference in critical thinking skills between students implemented by PjBL model learning and students implemented by the Problem Posing learning model. A summary of the calculation results of the Test of Between-Subjects Effect is shown in Table 2.

Table 2. Tests of Between-Subjects Effects

Source	Dependent variables	Type III sum of squares	df	Mean square	F	Sig.	Noncent. parameter	Observed power[b]
Corrective model	Critical thinking	.028[a]	1	.028	.001	.973	.001	.050
	Creativity	270.336[c]	1	270.336	14.666	.000	14.666	.965
	Communication	1558.692[d]	1	1558.692	6.736	.012	6.736	.725
	Collaboration	180.862[e]	1	180.862	5.545	.022	5.545	.641
Intercept	Critical thinking	32977.939	1	32977.939	1.317E3	.000	1317.458	1.000
	Creativity	152526.336	1	152526.336	8.274E3	.000	8274.452	1.000
	Communication	1568777.199	1	1568777.199	6.779E3	.000	6779.405	1.000
	Collaboration	182684.742	1	182684.742	5.601E3	.000	5600.542	1.000
Class	Critical thinking	.028	1	.028	.001	.973	.001	.050
	Creativity	270.336	1	270.336	14.666	.000	14.666	.965
	Communication	1558.692	1	1558.692	6.736	.012	6.736	.725
	Collaboration	180.862	1	180.862	5.545	.022	5.545	.641
Error	Critical thinking	1627.046	65	25.031				
	Creativity	1198.171	65	18.433				
	Communication	15041.219	65	231.403				
	Collaboration	2120.243	65	32.619				
Total	Critical thinking	34674.000	67					
	Creativity	154878.000	67					
	Communication	1592969.000	67					
	Collaboration	185869.000	67					
Total correction	Critical thinking	1627.075	66					
	Creativity	1468.507	66					
	Communication	16599.910	66					
	Collaboration	2301.104	66					

a. R Squared = .000 (Adjusted R Squared = -.015)
b. Computed using alpha = .05
c. R Squared = .184 (Adjusted R Squared = .172)
d. R Squared = .094 (Adjusted R Squared = .080)
e. R Squared = .079 (Adjusted R Squared = .064)

The third hypothesis testing was the same as the second hypothesis testing by using F_{value} analysis of the test of the between-subjects effect for the creativity model. Based on Table 02, F_{value} of 14.666 with a significance level of 0.000 is obtained. Based on the result, H_0 is rejected stating that there is no difference in creativity skills between students implemented using PjBL learning model and students implemented using the Problem Posing learning model. Since H_0 is

rejected, so H_1 is accepted stating that there are differences in creativity skills, between students implemented using learning PjBL model and students implemented using the Problem Posing learning model.

The fourth hypothesis testing was the same as the second hypothesis testing using the F_{value} analysis of the test of the between-subjects effect for communication skill. Based on Table 2, the value of F is 6.7736 with a significance level of 0.012. Based on the result, H_0 is rejected stating that there is no difference in communication skills between students implemented using PjBL model learning and students implemented using the Problem Posing learning model. Since H_0 is rejected, H_1 is accepted stating that there are differences in communication skills, between students implemented using learning PjBL model and students implemented using the Problem Posing learning model.

The fifth hypothesis testing was the same as the second hypothesis testing by using the F_{value} analysis of the test of the between-subjects effect for collaboration skill. Based on Table 2, F_{value} of 5.545 is obtained with a significance level of 0.022 lower than 0.05. Based on the result, H_0 is rejected which states that there is no difference in collaboration skills between students implemented using PjBL model learning and students implemented using the Problem Posing learning model. Since H_0 is rejected, H_1 is accepted stating that there are differences in collaboration skills between students implemented using model learning PjBL with students implemented using the Problem Posing learning model.

The results of the hypothesis tests were then integrated with descriptive statistics in the form of the average value of each variable described further in Table 3.

Based on Table 3 can be seen in critical thinking the average value of experimental class 1 (PjBL) is higher than that of experimental class 2 with a difference of 0.0411. Whereas in the average value of creativity, the experimental class 1 is also higher than the experimental class 2 with a difference of 4.0214. This also occurs in communication and collaboration skills where the average value in experimental class 1 is higher in than that of the experimental class 2. The differences between the two skills are 9.66 and 3.2893, respectively.

Table 3. The Difference in Average 21st Century Skills

Class		Mean	Std. deviation	N
Critical thinking	1	22.2286	4.58313	35
	2	22.1875	5.42656	32
	Total	22.2090	4.96514	67
Creativity	1	49.7714	3.89635	35
	2	45.7500	4.69042	32
	Total	47.8507	4.71700	67
Communication	1	1.5800e2	15.94476	35
	2	1.4834e2	14.36530	32
	Total	1.5339e2	15.85919	67
Collaboration	1	53.9143	6.42317	35
	2	50.6250	4.81094	32
	Total	52.3433	5.90468	67

Abilities and skills can help students in the future competition. For this reason, 21st-century skills are important to be developed in education especially in science learning which has a close relationship with the environment and the development of science and technology (Dewi, 2015). The 21st-century skills integration that is applied by using the right learning model is a wise step to improve students' abilities. In this study the overall test results of the multivariate test between 21st century skills and the Pillai's Trace learning model, Wilks' Lambda, Hotelling's Trace, Roy's Largest Root showed that a significance value of 0.000 was lower than 0.05 meaning there were differences in 21st century skills on the use of learning models. These differences were then elaborated on each model implementation.

On implementation of PjBL model which have the optimal result are creativity, communication, and collaboration skills. In the creativity skills through multivariate tests obtained a significance level of 0.000 lower than 0.05 so that it was stated that there were significant differences in creativity skills between learning using the PjBL and Problem Posing models. Creativity is the ability to produce new things or new idea. The process to produce new things can come from the imaginative process of the student him/herself. In this case, the student can gain ideas and comes from information and

previous experience about things that will be created; then students make a merger and renewal of works and ideas that have existed to produce new works and ideas, and different from the existing works. Based on the comparison of the average values it was also found that creativity in the experimental class 1 or using the PjBL model was higher than that of the experimental class 2 using Problem Posing model. According to Asmi, Hasan, and Safitri (2017), this is because PjBL learning puts forward a fun learning process and motivates students to learn. This is different from Problem Posing learning where students explore their abilities. The creation of works such as flipcharts applied in PjBL learning stimulates students to be more creative because the flipchart asks students to imagine, draw, and write.

Communication skills through a multivariate test were significantly valued at 0.012 lower than 0.05, which meant that there was a significant difference between the experimental class 1 using the PjBL and the experimental class 2 using Problem Posing. Direct communication usually occurs through oral presentations and discussions, then developed using indirect communication through visuals in the form of images or other media. Tank, and Coffino (2014) stated in communication the important thing is the use of language, which functions as a builder, constituent, and form of communication. Based on the results of the study, the communication skills of experimental class 1 were higher than that of the experimental class 2. This was because students were able to communicate well during learning and during learning, students were active by asking questions and conducting other positive activities.

Moreover, the implementation of flipchart-making was applied which required good cooperation and communication between students. This is similar to what Megawati, Suarni, and Sulastri (2013) who stated that the flipchart also trains students' verbal language, in the form of listening and speaking. Students communicate their idea directly. This was not found in the experimental class 2, where the average learning focused on the material and questions only.

Collaboration skills are also the same as the previous skills, where there were significant differences between experimental classes 1 and 2. Collaboration is often identified with the way individuals function in a group but emphasizes that collaboration is more than just cooperation. Collaboration is a way of teamwork in sharing tasks, interdependence, and how to solve problems together. In collaboration skills tested multivariate, it was found that the collaboration in the experimental class 1 was higher than that of the experimental class 2. This was because the learning PjBL applied to the study was carried out in teamwork, there was a good division of tasks so that teamwork was more meaningful. The collaboration was also performed in Problem Posing learning, but the division of tasks was less meaningful. Many certain students took over groups so that other students were less active and the contribution in groups was poor. Even though the collaboration meant was togetherness built by each in the team.

On the implementation of Problem Posing the four skills studied have not optimal than in PjBL model. From four skills, critical thinking has a different result with the other skills. In this study, the significance value of critical thinking skills score is 0.973, greater than 0.05. It means that critical thinking skills are not significantly different between the PjBL and Problem Posing learning models. This is because the two models encourage students to be active in learning and express opinions which then can be applied in tests of critical thinking skills. The result of differences in the average of the two models does not differ significantly, where in-class experiment classes one which implemented by PjBL obtained average 22.23, and class experiment 2 which implemented by Problem Posing obtained 22.19. So that it can be said that the best skill achieved by the students from four skills on the Problem Posing model is critical thinking skills. Critical thinking in learning activities is carried out by students who can answer questions about "how" and "why" by using principles and concepts. This is confirmed by the statement of Wirantini,

Negara, and Manuaba (2016) who said that the learning atmosphere using the PjBL model gave rise to interactions that occurred between students - teachers and students-students, encouraging students to carry out various learning activities. Enthusiastic students are shown by seriously doing various learning activities during the learning process. This activity raises the courage of students to ask questions, express opinions, and give suggestions so that interactions that occur in the learning process can change student behavior. Problem-posing, one of the learning models, also prioritizes students through two perspectives on cognitive activities, namely accepting and challenging. In learning, accepting occurs when students read a situation or information that is given by teachers and challenging occurs when students try to ask questions based on the situation or information provided. Based on this, it can be concluded that the two learning models can both improve students' critical thinking skills. Widayat, Wiyanto, and Hindarto (2017) state that the existence of learning models used continuously will foster students' critical thinking skills, and foster an environmentally caring character, so learning is more meaningful.

CONCLUSION

Based on the results and discussion, it can be concluded that there are significant differences in 21st-century skills between students who experienced by the PjBL model and students who experienced Problem Posing model. In PjBL learning the optimal value is obtained in the skills of creativity, communication, and collaboration. The results of the three skills showed that there were differences in creativity, communication, and collaboration skills between students in the class of PjBL model and students in the class of Problem Posing model. However, critical thinking skills differ from the other three skills. In this skill, there is no significant difference in critical thinking between students of experiment class 1 and students of experiment class 2. In the comparison of class averages, it appears that critical thinking skills in the PjBL model are higher than that of Problem Posing model so that it can be concluded that the most optimal results from the Problem Posing model are found in critical thinking skill.

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