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The effect of the PjBL learning model on PGSD student's ability in researching natural science

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Abstract: This research aims to get information about the effect of the PjBL learning model on PGSD students' ability to research ICT-based science research subjects. This research is an experimental study with a pretest-posttest control group design. The outreach population is all 6th-semester students of the ICT-based Science Research Program at Universitas Negeri Yogyakarta, and the sampling method uses Purposive Sampling. Data analysis uses a Variant Univariate Analysis T-Test on the significance level of 5%. The results showed that the project-based learning model increases positively and significantly towards students' ability and a significant difference of results towards students' ability between the group of students studying in the class with conventional methodology and PjBl methodology.
Keywords: project-based learning, student ability, science research.

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Introduction

Education can contribute to the meaning of someone's life by improving their ability to discover and create the meaning of life (White, 2009). Education is the conscious effort in the life process, so study activities have to be able to provide the study participants life ability or life competency compatible with the living environment as well as student's needs, furthermore, solving the problems effectively is highly important in study activities done through democratic teamwork (Mulyasa, 2015). The most crucial factor of modern education requirements is problem analysis ability and solution-creating ability. This is crucial as the focus of education in 21-century points to developing some abilities such as *higher-order thinking ability, deeper learning outcomes, and complex thinking and communication ability* (NSTA Board of Directors, 2011).

Natural science becomes one of the educational materials in college to develop these abilities. This statement follows the purpose of the natural science lesson, which is to transfer the concept and educate about identification, observation, hypothesis, and to find out and solve a problem (Rustaman, 2011). Natural science lesson is one of basic knowledge that becomes leading for information and technology development. To compete internationally, a reliable human resource is needed to face the information and technology development challenge (Hidayah & Pujiastuti, 2016).

Student's performance and interest over natural science lessons have involved some contextual, emotional, and motivational factors, including lesson' capacity, workload, and student's assignment, orientational ability and individual, instructional design and effective learning materials, efficacious teacher and teaching ability, motivation, and student's personality, class space size, etc.(Ale, 1989; Bietenbeck, 2011; Harris & Sass, 2011; Kirillova et al., 2017; Kwon, 2016; Rus et al., 2016; Say & Bag, 2017; Shcherbakov et al., 2017; Wang & Hsieh, 2015).

To activate student's activeness the in the learning process, the lecture can applicate various methods and develop innovative teaching materials; as a consequence, this is highly recommended in order the lecture to use the combination of teaching methodology while teaching adapted with the syllabus as one of the educational substances (Setiawan et al., 2020; Sudjana, 2004). This characteristic can be done well if a natural science studying student can understand and has a passion for natural science itself. On the other hand, educational personnel printing institutions (LPTK) must produce

teacher candidates already to deal with 21 century's challenge. This is supported by the research Faulkner and Latham (2016), which discusses the lecture quality in 21 century.

Based on the observation over elementary school program students of Universitas Negeri Yogyakarta, students are less enthusiastic about paying attention to their classmate's presentations and discussion results. Many of them are mumble, dawdle or mind their own business in the class and cannot focus anymore, presenting the materials too fast; any student who still struggles to identify the problems in research and is confused or has difficulty finding out the research' categories to be developed to be the research proposal in either reference or writing system.

The researcher concludes that it is necessary to develop the teaching material by using new and more interesting teaching methodology to student's attention. One of them is by using a *project-based learning methodology*. Project-Based Learning (PjBL) is educational methodology applying project/ activity as media? The education participants conduct exploration, assessment, synthesis, and information to create various studying results. The project-based learning methodology uses the problem as the first step in collecting and integrating new findings based on its experience in real activities (Menteri Pendidikan dan Kebudayaan Republik Indonesia, 2013).

Based on the phenomenon, the researcher would like to improve the educational process by researching with the title "the effect project-based educational methodology (PjBL) towards the elementary school program student's abilities in researching about natural science of syllabus".

This research purpose to discover, develop, and test the truth of knowledge by using scientific methodology. Generally, research means a process of collecting and analyzing data systematically and logically to reach certain goals. Tripodi et al. (1969) devotes that research is a systematic way to enhance, modify, and develop knowledge presented or(communicated) and tested (verified) by other researchers. Leedy et al. (2014) said that research is a process to get the answer systematically with supporting data towards a hypothesis, to solve a problem, or to understand deeply about a phenomenon, that process, often regarded as research methodology, has 8 various characteristics: (1) research comes as hypothesis or problems, (2) research needs a reliable hypothesis about its purpose. (3) research follows the specific procedure planning, (4) research generally divides the main problems into some parts managed more easily, (5) research is determined by the problem, statement, or specific hypothesis, (6) research takes certain critical assumptions, (7) research needs to collect and interpret data to solve the problem as the reason of the research, (8) research naturally works in circle way or to be more specific hectically.

Philosophy becoming the base of the study about this research's basic research ability is the essence of science because of science as product and process. Science is a product obtained through the active, dynamic, and explorative process from inductive activities (Carin, 1997; Hanifah & Irambona, 2019). Moreover, learning is based on constructive learning theory in view that learning is an activity building knowledge done by students themselves based on the experiences needed. Doing scientific activities with local wisdom, scientific research gives the knowledge understanding, basic thinking and high thinking develops critical, logical, systematical, discipline, objective, open, honest, cooperative, resilient, and motivated learning science. Besides, this will create natural ability through relevant activities. The basic natural ability from the natural methodology is meant as the natural investigation is applied in natural science learning and daily life. The basic ability is intellectual ability. In its learning, the supporting training of independent activity or small group can be done. At the college level, the natural ability is familiarly well known as the generic ability (Brotosiswoyo, 2000; Suma, 2003; Yunita, 2004). The educational methodology is a frame used in learning to achieve a certain goal. Moreover, it is also used by the educators as guidance in applicating learning in the group. Through educational methodology, the lecturer can assist the students in getting the idea, ability, mindset, and a way to express their idea.

Educational methodology plays a role as the guidance for stakeholders and lectures in managing the education activities. PjBL is an innovative approach for study teaching many highly essential strategies to success in 21 century (Bell, 2010). PjBL Model is an innovative learning model or approach emphasizing intellectual learning through complex activities. CORD (2001) learning focus sites on concepts and main principles of a study discipline includes students in investigating problem-solving and other-meaning task activities, provides a chance to the learners to work independently, construct their knowledge, and reach the peak in producing the product (Thomas, 2000).

Through PBL learning, the result is hoped to be more beneficial for students, and more independent in the study. In PjBL, students are sued to be able to solve the problem and finish the assignments. PBL learning has 13 significant potencies to make the study experience more attractive and valuable to adult learners as college students study at university or the traditional training to deal with job vacancies (Gaer, 1998; Rahayuningsih et al., 2018). Hence, in project-based learning, lecture, or instructors can't be active and train directly, but they can be a counsellor, facilitator, and figure out the student's mind. Learning with project-based learning methodology has the following advantages: increasing motivation, increasing problem-solving ability, increasing collaboration, and increasing resource managing ability. Moursund et al. (1995) conducted research about some articles of a project in the class to be considered testimonial materials towards teachers, mainly how the teacher uses the project and perception of its success.

The advantage attribute from project-based learning is as follows: first, increasing motivation. Many written reports of the projects show that students are always resilient until passing the time limitation. Hard-working in attaining the project, the lecture also has to report the progress in the absence and lessening the lateness. Students report that study in the project is more pleasurable than other curriculum components. Second, improving problem-solving ability. The research on students' high-level cognitive ability development emphasizes that it is essential for students to be involved in problem-solving tasks and for special learning towards how to find out and solve the problem. Many resources describing project-based learning environments lead students to be more active and successful in solving complex problems. Third, increasing collaborative ability, the importance of teamwork requires students to evolve and practice communication ability. Johnson and Johnson (1997) cooperative teamwork, student evaluation, online information are collaborative aspects of a project. New cognitive and constructive theories assert that learning is a social phenomenon and that students will learn more in a collaborative environment (Deveci, 2018; Vygotsky, 1978).

For increasing resource managing ability, a part of being independent students is the responsibility of completing complex assignments. Project-based learning implemented well provides the students training and practice in organizing the project and makes time allocation and other resources as pieces of equipment to finish the tasks. When learners work as a team, they find planning, organizing, negotiating and consensus making abilities of task issues to do, who is responsible for each task, and how the information will be collected and presented. Identified ability by students is an essential ability in the working world later. As the essence of work is collaborative, so the development of abilities is taking place among students. In project teamwork, individual strength and study method are referred to strengthen the teamwork as a whole PjBL learning model syntax as follows: First, Preparation, the educator sets up the design or makes the beneficial project framework in providing the information needed by students in evolving the mindset of the project following with the planned framework and in providing a resource to assist its process. This will support the student's success in finishing a project and be supportive enough in answering the questions, doing activities, and making creations. The framework becomes an important material to be read and implemented by students, so the teacher has to play their role procedurally in analyzing and integrating curriculum, collecting the questions, searching web site or source to support the students in finishing project, and storing it in the web.

Second, assignment of choosing the topic. Corresponding to the project assignment given b teachers or their own choices, students will understand the project framework and then try to look for the supporting source. Third, planning the program. Students work as an individual project, a team in the class or among the classes. Students determine the program and steps to be taken according to the topic. The planning execution time of all subs if in the team, each member is to follow the role and has a responsibility—fourth, investigation and presentation. The investigation here includes programs such as asking the experts and sharing the experience and knowledge among teams. In its development, it periodically includes observation, experiments, and field trips. Fifth, Finishing. Students make reports, then present those in the class.

As a result of its program, then teachers and students make a note about the project for the next development. The participants have feedback over what they made from the teams, friends, and teachers. Sixth, Monitoring/Evaluation. The teacher assesses all processes in executing the project done by each team based on its participation and productivity while finishing the project. Project in this project-based learning is guided by the inquiry questions encouraging the research and making students possible to practice the knowledge they grasped (Bell, 2010). The project includes students in the investigation,

which may be in the form of the designing process, making the decision, detecting the problem, discovering, solving the problem, and building a model. But, to be considered a project is meeting the criteria of project-based learning, these activities include the knowledge transformation and construction (by the meaning of new understanding or new ability) on the learner side (Bereiter & Scardamalia, 2000; Breiter et al., 2005).

This research is conducted to 6-semester PGSD students of Universitas Negeri Yogyakarta on ICT-based natural science; the researcher's reason of conducting the research cames as the students are less active in learning, when the presentation, there are still many of them less paying attention to other students presenting their discussion results, monologue, joking or playing gadget, presenting the materials too fast, any students still getting difficult to identify the problem in the research, any students still having problem in determining the types of research to be evolved to be the research proposals, as well as having weakness in preparing good research proposals in the reference and writing system. The research aims to find out the correlation or effect of the PjBL learning model applied in learning towards PGSD student's abilities in researching on the ICT-based natural science research course.

The benefits from this research include the theoretical benefit hoped to provide an overview about the PGSD students abilities in researching in learning process applying learning model (PjBL) and if reviewed practically the benefits are as follows, first, for students to know the student ability levels in researching natural science research courses. Therefore, to know the student's ability levels in researching regarding ICT- based natural science research courses, the student is hoped to arrange the research proposals about the findings or problems they have found. Second, for the lecture as an example or motivation to improve, develop, and upgrade learning methodology following the student's characteristics and materials on natural science research courses. Therefore, the lecture is encouraged to give lessons with that model, as a consequence, to increase the student's independence on natural science research courses. Third, for the researcher as the experience in conducting research aiming to find out the impact of applying the model to student ability levels in researching of ICT-based natural science research courses. Besides, the researcher can identify the real condition in the field in implementing the learning model. So it can be a reference later in PGSD student learning practices

Methods

This research uses a quantitative approach with pseudo experiment research type, with pre-test post-test control group design model. This research is conducted in Universitas Negeri Yogyakarta on PGSD students about the ICT-based natural science research program from January to April 2020. The population in this research is all 6th-semester students on ICT-based natural science research courses of Universitas Negeri Yogyakarta. The collecting sample is done with a purposive sampling model

Variable of Research

This research uses independent variables and dependent variables. The independent variable in this research is symbolized as (X) is Project-based learning, meanwhile symbolized as (Y) or the dependent variable is PGSD student's understanding ability of researching of ICT- based natural science research courses.

Technique and Data Collection Instrument

The data collection technique in this research is by test. The test is a written test to know the student's understanding in conducting natural science research. The test is made in the first learning and after attending the learning (post-test). As for the test form, the research uses a description form.

Instrument Validity and Reliability

Instrumen validity includes content validity and constructs validity. These validities are obtained by making instrument lattice, and the next is making technique (experts judgment) from the lecture. After the instrument gets approval from the experts, the experiment is analysed using product moment. The instrument reliability test is done by referring to the Alpha Cronbach. Coefficient value. Validity and reliability test result can be seen in Table 1 and Table 2.

Based on Table 2, as the reliability coefficient clarification has been specified, Instrument trails results used in this research get reliability coefficient value counted for 0,920 that reach the reliability criteria of very high. Moreover, reliability calculation is done by using SPSS 23,0 for windows.

Table 1. Validity item of students understanding ability test in researching in significance level, a 0.05 (0,3297)

No	Correlation coefficient	Interpretation
1.	0.910	Very high
2.	0.875	Very high
3.	0.955	Very high
4.	0.802	Very high
5.	0.877	Very high
6.	0.871	Very high
7.	0.558	sufficient
8.	0.757	high

Table 2. Instrument trials reliability

Cronbach's Alpha	N of Items
0,920	8

Data Analysis Technique

The data analysis technique in this research uses description and inferential statistics. Descriptive analysis is used to present the data obtained from pre-test and post-test results towards student ability in researching on the experiment team and control team in the form (mean, minimum, and maximum score) to be presented on the table to be easier to understand. The inferential analysis is used to examine the hypothesis that has been made. Before the data inferential statistic test (T-test), data is to fit qualify pre-analysis test requirement, namely normality and homogeneity test. The normality test is used by using the Shapiro Wilk methodology.

The normality test is used to know whether the data is normal or not; meanwhile, the homogeneity test is used to know from which population the data is homogenous. The homogeneity test univariate uses *Levene's Test*. Data is presumed to be normal distribution and homogenous if the significant value is more than 0.05 (>0.05). The normality and homogeneity test uses SPSS 23.0. for windows.

A univariate average test precedes the hypothesis test using an independent t-test with Sig (2 tailed). This test is done to detect the impact of the PjBL learning model on PGSD students' ability to research ICT-based natural science research courses.

Results and Discussion

Descriptive analysis is used to describe the data. To describe experiment and control classes pre-test and post-test data, it is used statistic technique including the average (mean), minimum and maximum scores before pre-test on experiment and control classes, which can be seen in Table 3.

Table 3. The Early Student's Ability Data (Pretest)

Group	N	Highest score	Lowest score	Average
Control	22	93	31	71
Experiment	22	91	56	73

Based on the Table 3 average of the early-ability score in doing research the students achieve on both samples is obtained that the value is not too different specifically 73 for experiment class and 71 for control class with the scale of (0-100) so, it can be concluded that early student's ability score in making research on both classes is balanced. The post-test score mean of student ability in conducting research of both experiment and control classes can be seen in Table 4.

Table 4. The last student's ability data (post-test)

Group	N	Highest score	Lowest score	mean
Control	22	92	55	79
Experiment	22	100	72	87

Based on Table 4 score mean of student's ability in conducting research attained by students on both samples obtained too much different that is 87 for experiment class and 79 for control class (1-100 scale), so it can be summed up that student's ability score in researching on the experiment class and control classes is not balanced, meaning that there is a significant difference of mean between experiment and control classes.

Analysis Pre-Requirement Test Result

Before the hypothesis test, the pre-requirement test that must be completed is the normality and homogeneity test for each group. Here is the presented analysis result of normality and homogeneity tests. The normality test results can be seen in Table 5 and Table 6.

Table 5. Pretest Normality Test Result

Variable	Group	*Saphiro Wilk*		
		Statistic	df	sig
Student's ability	Experiment	0.967	22	0, 646
	Control	0.927	22	0,109

Based on Table 5, the data normality test statistic output results of students' ability to conduct research mentioned in Table 5 seem on the table *Shapiro-Wilk Test*, Sig. Value for student's ability testing data in researching natural science in the experiment class is 0.109. As all variables have a probability value higher than the α (0.05) null hypothesis, each group's real level of 5 % is accepted. So, it can be summed up that each group is from a normally distributed population

Table 6. Post-test normality test results

Variable	Group	*Saphiro Wilk*		
		Statistic	df	sig
Student's ability	Experiment	0.943	22	0, 229
	Control	0.929	22	0,115

Based on Table 6, the normality test statistic output result of students' ability to research according to the result on Table 4 shows that on the *Shapiro-Wilk Test table,* Sig. The value for student ability test data in conducting research related to natural science for both experiment and control classes is 0.115 because all variables have a higher probability value than α (0.05), indicating that the significance level 5% null hypothesis of each group is accepted. So, each group is from the normally distributed popular-tion. The homogeneity test results can be seen in Table 7 and Table 8.

Table 7. Pretest Homogeneity test result

Lavene Statistic	df1	df2	Sig
3.025	1	42	0.089

Based on Table 7 data variant homogeneity test result of student's ability in conducting research seems that a sig. value: 0.089 higher than a = 0.05 that means that real level 5 % null hypothesis is accepted. Therefore, it can be concluded that both groups (experiment and control classes) on the pre-test are equal, indicating that both classes are homogenous.

Table 8. Post-test homogeneity test results

Lavene Statistic	df1	df2	Sig
3.391	1	42	0.073

Based on Table 8, variant homogeneity test results of student's ability in doing research show that Sig. value: 0.073 higher than a = 0.005 indicating that on significance level 5% null hypothesis is accept-ed. Then, it means that both group variants (experiment and control classes) on post-test are equal, or both classes are homogenous.

Inferential Analysis

The inferential analysis is used to examine the hypothesis that has been made.

Hypothesis Test Results

After the normality and homogeneity analysis, the pre-requirement test result has been completed. Accordingly, the analysis done is the hypothesis test.

Univariate test

The hypothesis testing includes variables to get hypothesis test; there is a hypothesis tested is the impact of PjBL learning model (X) towards PGSD student's ability to research ICT-based natural

science (Y). Data testing for this research's hypothesis test uses SPSS program 23 (*Compare Means-Independent Sample t-test analysis*).

From independent test result of T sample test, if seen from other criteria, that is Sig (*2tailed*) <a or 0.005 < 0.0, so, Ho is rejected, on the significance level of 5%, then, it can be concluded that student's ability in researching ICT- based natural science, getting lessons with PjBL model higher than student's ability getting conventional lessons.

Discussion

Based on statistic hypothesis test results from the above clarifications, the hypothesis in this research can be expounded as follows. The analysis result shows that homogeneity rejection of student's ability in conducting research getting lessons with Project-Based Learning model (PjBL) is equal or lower than student's ability with the conventional model, indicating that learning model influences towards PGSD student's ability in researching of ICT-based natural science. The conclusion is that PGSD students' ability to do research getting lessons with the Project-Based Learning model (PjBL) is higher than students' ability to take lessons with conventional lessons.

There is a student's researching ability difference between those who get the lessons with the Project-Based Learning model (PjBL) and the conventional model caused by experience, cognitive ability, and environment. Besides, increasing the student's understanding ability with the PjBL model has effects and influences student's mental motivation performance (Sari, 2018). Shin (2018) showed that project-based learning has advantages in student study motivation, especially student's attention and relevance, both influence collaborative learning (Chiang & Lee, 2016). PjBL model implementation has also assisted students in obtaining the ability in reading relevantly, such as *skimming* and *scanning, gathering* information and *identifying* relevant ideas related to project done by their groups (Musa et al., 2012). Besides, PjBL can also improve student's psychomotor ability and concept understanding (Sumarni et al., 2016). Mahasneh and Alwan (2018) said that project-based learning implementation allows students to plan their study to be easier, work collaboratively with their peers, and succeed in finishing their project on time. According to Afriana et al. (2016), project-based learning integrated with STEM can increase students science literation ability.

PjBL is an effort to make learning centered on students in which project assignments are being examined and finished. The more assignments are, the more students feel motivated to do a project can be seen as various organizing methods simultaneously. The learning process integrated PjBL means developing students' ability to learn actively, think critically, and solve the problems of the problem-focused teaching process to encourage students to do group discussions. Anazifa and Djukri (2017) state that project-based learning and problem-based learning affect students' creativity and critical thinking. There is a different effect attributable to project-based learning and problem-based learning students' creativity. PjBL offers an interesting alternative to traditional education by shifting education focus from what teachers teach, and students learn. No matter how good the learning model is, the lecture's presence cannot be substituted by any technological advancement. The lecturer's ability in applying the learning model is highly influential towards student's success. Accordingly, if the student is comfortable with the learning model applied, it does not matter for the student to understand the lecturer's concept. Hugerat (2016) said that teaching science with project-based learning significantly improves teacher-student relationships and a better learning atmosphere. A project program is a learning program aiming to develop science processability; through the project, students can be more active in learning and understand the concept (Citradevi et al., 2017).

Based on the theory, the study does not just include the relation between stimulus and response but also learning to perform complex thinking processes. Furthermore, for more detail, in theory, it asserts that knowledge is built in the person through interaction sustainably with the environment. The project-based learning model can improve students' problem-solving and competence abilities (Ismail, 2018; Jalinus & Nabawi, 2017; Wiek et al., 2014). If it is observed from the psychological perspective, the learning model is from cognitive psychology rooted from assumptions that study is the behaviour-changes process of experience. Through this learning model, study participants can develop comprehensively, meaning they will grow better in cognitive development and psychomotor and affective aspects automatically for the problems they face. From the above discussion, it can be concluded that student's ability in research with the Project-Based Learning model (PjBL) is more significant than that

with conventional-based learning, either in general or in the review of testing results proven as its validity.

Conclusion

Based on the research results that have been presented, some explanations can be summed up. For the clarification of the conclusion, that is as follows. **First**, the project-based learning model has an impact, improving the student's understanding ability in doing reach significantly. Learning with the project-based learning model allows students to gain the experience of active study. Consequently, they have a new experience individually or as a group. Steps on project-based learning model transform student's habits from depending on the lecture to study, giving a chance to students to be able to explore their knowledge. Changing the student's habits of depending on the project-based learning model significantly impacts the indicator and presents the concept in various forms of understanding representation. **Second**, conventional learning does not give the effect of the significant increase towards the whole understanding indicator. That can happen as in the learning process, students listen to only the lecturer's clarification about research, so some students can not comprehend it. The increase of understanding in conducting research is due to the lecturer who delivers their lecture well from planning to executing. The lecturer can maximize their performance in teaching conventionally, that is, by giving the information. As a result, students can respond actively reflected by answering the questions and gaining the information the lecturer delivers. **Third**, learning with the project-based learning model improves students' ability level researching than that with the conventional learning model. Both concepts in the class get the same treatment in the thinking stages. But in obtaining knowledge terms, they are given different stimulus Project-based learning model attains knowledge based on meaningful learning. The meaningful learning is from the problem-solving process through creating the product (proposal). The lecturer facilitates the students with discussion activities and collaborates with the team to expound on problem-solving strategies. Meanwhile, in conventional learning, that takes place only in one direction, from lecturer to students or no feedback from both sides.

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