

IMPROVING STUDENTS' SCIENCE ACHIEVEMENT THROUGH THE IMPLEMENTATION OF PROJECT-BASED LEARNING

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ARTICLE INFO

Article history:

Received 19 October 2019

Received in revised form

15 December 2019

Accepted 25 December

2019

Available online 20 January

2019

Keywords:

Critical Thinking Skill,
Project-Based Learning,
Science Achievement

ABSTRACT

Science learning is said to be more meaningful if students are involved in various project activities and their achievements during the learning process are often associated with their critical thinking skills. In this regard, this paper aims to find out how science learning outcomes in terms of critical thinking skills are enhanced through the application of project-based learning. The research design used was a post-test only control group design with a total sample of 128 Grade V students of Cluster I in Buleleng District. Data collected through tests and analyzed using ANAVA two paths to determine the effect of learning models on science learning outcomes in terms of critical thinking skills and the interaction between learning models with critical thinking skills. The results of the analysis show that 1) there are significant differences in science learning outcomes between students who take project-based learning and students who use conventional learning models; 2) there is a significant interaction between the application of project-based learning models and critical thinking skills on the learning outcomes of Natural Sciences; 3) students with high critical thinking skills tend to show more significant results on improving learning outcomes. However, the results of this study are limited to the measurement of critical thinking skills so that further research is needed by paying attention to other mediator variables.

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1. Introduction

Education is very important for a country with the thought that developing countries are countries whose people have high quality education. In other words, education is an absolute necessity for a person. The fact is that most parents send their children to school to get a better education. Some parents send their children to private institutions to get the additional education they need. In fact, some of them send their children to international schools (international schools) where they are prepared to face the global world. With these considerations, educators are expected to be able to teach children various sciences and social skills with the world to face and survive in the era of globalization so that they will have direction and purpose in their lives.

The era of globalization emphasizes education to develop children's competitive feelings. Through this development, education will create a new orientation which is to get meaningful education at every level of education. According to Dantes (2008: 1), compared to less meaningful education which will only become a burden of life, meaningful education helps children deal with changes in life. This shows that education should provide meaningful knowledge and experience for children who are relevant to everyday life. Through education, every child will get not only the opportunity to increase knowledge, skills, and values but also knowledge to solve problems.

This indicates that the implementation of relevant education is the main focus in the world of education. Relevant education according to Dantes (2008) should be based on four pillars of education, namely 1) learning to know where children learn many things to gain knowledge, 2) learning to do where children use their knowledge to develop their competencies and share, 3) learning to be where children

learn to use their competencies for life, 4) learning to live together where children are interdependent) and how to respect others is very important in social interaction. By considering these four pillars, the goal of education can be achieved. Therefore, one indicator of a meaningful education is the implementation and development of an appropriate curriculum that can meet educational needs.

As explained in Law No. 20/2003 Chapter I Article 1: 19, the curriculum is a plan and order regarding objectives, content, material, and also techniques used as guidelines in carrying out learning activities to achieve educational outcomes and objectives. This means that the curriculum used to achieve educational goals is a curriculum that is able to meet the needs that are in accordance with daily life. In Indonesia, the curriculum applied at each level is the 2013 Curriculum. This curriculum is a development of the previous curriculum with several changes regarding the main focus or goal. These changes are the initial thought of the government as an effect of the development of science and technology that affects human needs for education. These changes are the government's goal to reach future needs by focusing on students' competencies so that their own quality can be shown.

One aspect that is used as a reflection of the quality of education is the learning outcomes achieved by students. Thus, learning outcomes will be the main indicator in determining the quality of education in all subject groups. One of them is Sciences. Iman et. al (2013) explain that science education is expected to be a vehicle for students to learn about themselves, the environment, or prospects for further development. In its application in daily life, the science learning process emphasizes on providing direct experience to develop competencies in order to explore and understand the nature around scientifically. This direct learning process is what is meant by meaningful learning (Dantes, 2008). AAAS (1989) and NSTA (1992) in Greenwald (2001) say that science education teaches students to think critically and solve problems that stimulate students to explore through curiosity, asking questions, expressing ideas, learning from mistakes, and perseverance. Therefore, learning science must take place meaningfully through inquiry and express ideas, which means that this learning aims for understanding not memorization.

The main problem here, especially in elementary schools in Buleleng District, mostly shows that students are less able to show their ability to solve the problems identified. This can be seen from the low activity of students in learning, both physical activity, mental, and emotional activity (Faith et al, 2013). This is caused by the use of lecturing method which causes students' low concentration in learning. Even, students are frequently assigned to answer questions in textbooks or worksheets. Certainly, these activities will not make students improve their critical thinking skills. Ang and Wang (2006) argue that the difficulty of students in understanding the concept of science is actually due to some science material that is so abstract that students have difficulty in seeing directly or experiencing it. In other words, students do not have the opportunity to construct the knowledge gained and relate it to real life so that students have difficulty in daily lives application.

This can reduce students' motivation and interest in science, and even lead to negative attitudes towards science learning. Suryabrata (2001) adds that if students only memorize the contents of the material, then when the student graduates from school, they are only theoretically smart but poor in application. This learning process will not form intelligent students who have the ability to solve life problems and do not form creative and innovative people. Only those who have life skills will be able to survive in their lives and make their lives more meaningful. The meaning of life takes place in its context, which is why lessons will become meaningful when it links to the real life context of students.

Contextual learning is learning that helps teachers relate subject matter (content) to students' real world situations (context) and encourage students to make connections between the knowledge they have and their application in their daily lives (Johnson & Johnson, 2002). There are many ways of applying meaningful learning methods that focus the learning process on students, so the learning process will occur in two directions where there is an active role of students, so that learning objectives will be achieved. One approach that is considered appropriate with contextual oriented science learning and applying it in everyday life is Project Based Learning.

Project Based Learning (PjBL) is an authentic form of learning for students (Marhaeni, 2008). According to Steinberg (1997 in Mergendoller & Thomas, 2001), PjBL is a learning model that uses projects to motivate and focus on learning. Projects in PjBL are included in the authentic category which provides meaningful impressions in learning (Dantes, 2008). These PjBL characteristics include building student awareness of their responsibilities in performing assignments, emphasizing quality student performance, conducting work group reviews and conferences, and assessing students through the quality of their performance (Dantes, 2008). In its implementation, students need a lot of time starting from the planning stage until it will end on the product or presentation.

Blumenfeld et. all (1991 in Kubiатko & Vaculova, 2011) explain that in PjBL, students are required to carry out a project that starts with a question or problem which is then used to conduct research, and this research will end in a product that contains the answers to those problems. PjBL as a learning method is suitable for developing thinking competencies and building a flexible learning environment for students. Bereiter & Scardamalia (1996 in Kubiатko & Vaculova, 2011) explain that PjBL has the same concept as knowledge building which emphasizes on increasing knowledge such as explaining and demonstrating.

Ansori (2014) also adds that this learning model has great potential to provide a more interesting and meaningful learning experience for students. The results of research in America show that project-based learning has shown satisfying results (Richmond & Striley, 1996 in Ansori: 2014). This learning model focuses more on meaningful life problems for students, the role of the teacher presents the problem, asking questions and facilitating students in designing a project which they will then do in the time the teacher has provided in accordance with the concepts being taught. Eventually, students will understand the concept with the projects they are doing. And this will increase student creativity.

In enhancing students' creativity, Klein et. all (2009) suggest to apply PjBL for it provides opportunities for students to demonstrate their knowledge such as creating and presenting a project according to their abilities. PjBL also provides opportunities for students to work in groups like a real research group. When the results of projects are able to be used to assess their knowledge and abilities and the level of their understanding of the material being studied, PjBL provides opportunities for students to think critically and ask questions about a topic.

Accordingly, it can be said that one important factor that can influence the achievement of learning outcomes is the ability to think critically. Critical thinking is meant as thinking right in the search for relevant and reliable knowledge about the real world. According to Fisher (2010) in Afandi et. all (2012), critical thinking ability is described as an active process involving the role played by students' metacognition (thinking about one's own thinking). Johnson (2000) in Susilowati (2013) adds that critical thinking includes mental processes that are well organized and play a role in the decision making process to solve problems by analyzing and interpreting data in scientific inquiry activities. According to Joyce (1992) in Susilowati (2013), this ability is needed by students as a basis for understanding various things such as understanding concepts in scientific disciplines. Students who have this ability are able to ask suitable questions, gather information, put forward logical arguments based on information and take credible conclusions.

Based on the background above, it is necessary to conduct a study to improve the upper class students' science learning outcomes viewed from their critical thinking skills by applying Project Based Learning in Cluster I in Buleleng District.

2. Methods

This research is a quasi-experimental study using a two factor design where the treatments are arranged so that each individual can be the subject simultaneously in two different factors in which each factor consists of several levels (Dantes, 2012). In this design, the experimental group was treated by using PjBL learning model, while the control group was given the conventional learning model.

The population used in this study were fifth grade elementary school students in Cluster I Buleleng District by only taking 4 schools as research samples. SD Negeri 1 Banyuning and SD Negeri 5 Banyuning were selected as the control group and SD Negeri 2 Banyuning and SD Negeri 8 Banyuning as the experimental group with a total sample of 128 students. Data was collected through tests and analyzed using two way ANAVA analysis. Below is the data analysis design.

Table 1
Data Analysis Design.

Kemampuan Berpikir Kritis	Strategi pembelajaran	
	PjBL (A1)	Conventional (A2)
Tinggi (B1)	A1B1	A2B1
Rendah (B2)	A1B2	A2B2

Two way ANAVA analysis was done to find out 1) significant differences between students who took the PjBL learning model and students who took conventional learning; 2) the effect of the interaction between the application of the PjBL learning model and students' critical thinking skills on the learning outcomes of Natural Sciences; 3) the difference in science learning outcomes between students who are

taught with the PjBL learning model and students who are taught with conventional learning in students who have high critical thinking skills; and 4) the difference in science learning outcomes between students who are taught with the PjBL learning model and students who are taught with conventional learning in students who have low critical thinking skills. According to Candiasa (2010), if the significance number (sig.) is smaller than the significance level α (0.05), the statistic obtained is significant, so the null hypothesis is rejected. Conversely, if the significance number (sig.) is greater than α (0.05), the statistical number obtained is insignificant, which means the null hypothesis is accepted and the alternative is rejected.

3. Findings and Discussion

The results of the analysis using two-way ANAVA test showed a significant difference. The recapitulation of the results of the analysis is presented in table 2 as follows.

Table 2
Tests of Between-Subjects Effects.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	469.238 ^a	3	156.413	29.578	.000
Intercept	53101.714	1	53101.714	1.004E4	.000
Kelompok	25.190	1	25.190	4.764	.032
Kbk	32.190	1	32.190	6.087	.016
kelompok * kbk	411.857	1	411.857	77.884	.000
Error	423.048	80	5.288		
Total	53994.000	84			
Corrected Total	892.286	83			

Dependent Variable: Y

a. R Squared = .526 (Adjusted R Squared = .508)

The table above shows that the significance level between the model groups is less than 0.05 ($p < 0.05$), which means that there is significant difference in learning outcomes between students who take PjBL learning model and students who follow conventional learning models. The application of project-based learning models can have a better effect compared to conventional learning models. The difference is due to differences in the treatment given during the learning activities. Afriana (2015) explains that project-based learning is a learning model that organizes classrooms in a project where students must build and apply concepts from the resulting project by exploring and solving real-world problems independently. Through the provision of this learning model, students will have an active role in learning so that they will directly gain learning experiences through the activities they undertake.

In contrast to conventional learning that uses the usual lecture method, the delivery of material in the learning process is more centered on the teacher and the communication is done in one direction from teacher to student. In addition, conventional learning is mostly done by lectures, questions and answers, and assignments that take place on an ongoing basis. The teacher acts as a source of information while students become good listeners. If an activity like this is done repeatedly, it will have an impact on students' enthusiasm for learning which can affect the quality of their learning outcomes. Students will become bored and ignore the teacher's explanation so that they become inactive in learning. The difference in the way of learning will certainly have a different impact on learning outcomes achieved by students.

Other studies conducted by Kamayani et al. (2013) also showed the same thing. Learning by using a model of learning projects has a significant effect on student learning outcomes in science. In the experimental group that uses the project learning model, students are given the opportunity to discuss, nurture direct discoveries of real-world problems, which give them pleasure in learning and can be made as effective teaching strategies. In addition, centered learning activities on students provide opportunities for students to investigate the topic of the problem. This opportunity makes students more autonomous so that they can build their own knowledge and learning becomes more meaningful. Based on this explanation, it can be concluded that the application of project-based learning model is more effective to be applied in improving student learning outcomes. Solihat et al. (2015) also say that the project learning model makes students learn through their experience in formulating problems to explain the

phenomenon under study. Learning activities like this provide a direct learning experience. This experience makes learning more meaningful so that the concept of the material learned will be stored for a long time. In addition, scientific activities in the project learning model make students more enthusiastic and happy during the learning process.

The result of the analysis also shows that there is an interaction effect between learning models with critical thinking skills on students' science learning outcomes with a significance level of $p < 0.05$. Science subject is a science that is very closely related to the natural environment around students that direct students to think, behave, and act scientifically in everyday life and it needs the ability to reason and think critically. Hasanah (2016) explains that critical thinking is a cognitive ability to express something based on reason and strong empirical evidence. So students are said to think highly critically if they can evaluate facts, assume based on logic, analyze and assess through observation, experience, or communication as a basis for an action so they can draw conclusions. To facilitate students who are capable of critical thinking, learning models are needed that can enable them to use their abilities to be able to find solutions to problems based on logical and objective considerations. By facilitating students' abilities through this learning model, student learning outcomes also improve. It is, indeed, in contrast to students who think critically at a low level where the learning model will have less effective influence on learning outcomes. This is due to the limited ability of students to carry out scientific activities. Lack of student sensitivity by being taught in the activities of formulating, analyzing, and concluding problems will make students have a wrong concept so that it will affect their learning outcomes.

In relation to this, Kiswanto et al. (2016) suggest that students with high creativity and high critical thinking skills learned by using project-based learning have better average learning achievements compared to students with creativity and low critical thinking skills. This is because students with a high level of creativity and critical thinking ability are able to hone their abilities through the learning models provided. They get the chance to practice improving their abilities such as conducting investigations, concluding, and finding solutions to problems. In contrast to students whose creativity and critical thinking skills are low, they will experience difficulties in learning. This is due to their inability to solve a problem. Students with low levels of creativity and critical thinking skills are more likely to be passive during this learning so that it will have difficulty in constructing understanding of the concept. This explanation indicates that the interaction between learning model with creativity and the level of critical thinking skills will affect student achievement.

The result indicating the positive interaction between project-based learning and the level of critical thinking was in relation to the result of Tukey test that showed the value of Q_{count} was 11.04. Due to the greater Q_{count} than Q_{table} at 0.05 significance level ($11.04 > 2.95$), it means that there is a significant difference in the learning outcomes of science between groups of high critical thinking skill students who take project-based learning with groups of students who follow conventional learning. Students who have high critical thinking skills will tend to want to know far more and study about what they want to know. The characteristics of natural science learning that need concentration, accuracy, and scientific attitude and memory are inseparable from the effectiveness of the teacher managing the class and the creativity of the teacher in presenting the material so that students easily accept the material. In project-based learning, the ability to provide provisional estimates of problems is needed, which is then proven through investigative and experimental activities by linking theories that have been learned. Therefore, students who have high critical thinking skills have more opportunities to express their ideas so that the learning outcomes will be better.

Prayitno (2010) concludes that by implementing project-based learning, students are required to be active in the learning process. They will feel firsthand in developing learning and gaining knowledge. This is due to the direct involvement of students in finding information or learning material through the steps of contextual activities such as making observations, researching, class discussions, and presenting their findings or thoughts. They are also trained to sharpen their critical thinking towards solving a problem discussed in project learning. So for students who have high critical thinking skills, their abilities will be increasingly honed through this learning model.

Sastrika et al. (2013) reveal that for students who are capable of high critical thinking, the project-based learning model provides more space for independent learning so as to provide better value of concept understanding and critical thinking skills compared to conventional learning models. Project-based learning facilitates students' critical thinking skills in problem solving, decision making, researching, presenting, and making documents. This learning is designed to be used in complex problems that students need to investigate and understand so as to enable students to look at ideas in different ways and promote critical thinking about the problem at hand.

For groups of students with low critical thinking skills, there is a significant difference in the science learning outcomes between groups of students who take a project-based learning model and groups of

students who follow conventional learning models. It was proven by the result of Tukey test which also showed that the Qcount value of 6.66 was greater than the Qtable of 2.95 at a significance level of 5%. In science learning, the concept of science includes natural and scientific aspects that require logical thinking skills. In this case, students will find it difficult to obtain the knowledge needed if they have low critical thinking skills and lack of motivation because of their inability to produce a logical argument. Basically, groups of students with low levels of critical thinking skills do indeed need intensive guidance by the teacher. Payani (2015) states that students with low critical thinking ability will experience difficulties in carrying out scientific activities. Students do not have the skills for this activity so it will have an impact on misconceptions about the material being studied. This resulted in the low learning outcomes obtained. As for the group of low-ability students who are taught with conventional learning models, there are no problems encountered in learning. For this group, activities such as listening to the teacher's explanation, taking notes on the material presented, memorizing, and working on objective questions are necessary activities. Because they are not able to produce a concept derived from the results of logical and critical thinking and assume the teacher's explanation is more effective, this conventional learning model is the only way of learning that is suitable for them. So that their learning outcomes will be higher than the group learned by the project-based learning model.

Based on the findings in this study which show that the science learning outcomes of students who take a project-based learning model are better than students who take a conventional learning model. For these findings, the teacher's role in determining suitable learning models applied in the classroom during the learning process by considering the characteristics of students is important. If the learning model to be applied is able to foster students' enthusiasm for learning, it can be said that the educational process can run effectively. Therefore, the success of a learning actually cannot be separated from the teacher's ability to develop learning model. The development of appropriate learning model aims to create learning conditions that enable students to learn actively and fun so that students can achieve optimal learning achievements and results.

4. Conclusion

Based on the discussion above, it can be concluded that 1) there is an influence of learning models on student learning outcomes where project-based learning provides a better effect than conventional learning; 2) there is a significant effect of interaction between the application of the project-based learning model and critical thinking skills on the learning outcomes of science in students; 3) students with high critical thinking skills who take part in project-based learning get higher learning outcomes compared to students who take conventional learning; and 4) students with low critical thinking skills who take part in project-based learning get lower learning outcomes compared to students who take conventional learning. Therefore, to produce maximum output from students in the future, it is recommended that teachers help hone the students' critical thinking skills by using more innovative learning model, for example the PjBL learning model. Due to the benefits of implementing this learning model and supported by the results of this study, the use of PjBL learning models is highly recommended to help students improve and maintain desired learning outcomes.

References

- Afandi, Sugiyarto, & Sunarno, W. (2012). Pembelajaran Biologi Menggunakan Pendekatan Metacognitif Melalui Model Pembelajaran Reciprocal Learning dan Project-Based Learning Ditinjau Dari Kemandirian Belajar dan Kemampuan Berpikir Kritis Mahasiswa. *Jurnal Inkuiri*, 1(2) p. 86-92.
- Afriana, Jaka. (2015). Project-Based Learning (PjBL). Online source on <http://www.researchgate.net/publication/289526009>
- Ang, Kim Hock; Qiyun Wang. (2006). A case study of engaging primary school students in learning science by using Active Worlds. *Proceedings of The First International LAMS Conference 2006: Designing the Future of Learning*, p. 5-14
- Ansori, Ayub Al. (2014). Penerapan Model PjBL (Project-Based Learning) dalam Upaya Meningkatkan Kreativitas Siswa Pada Konsep Pencemaran Lingkungan Di Man Babakan Ciwaringin Cirebon. *Thesis*. Online source on http://www.academia.edu/2314979/PENERAPAN_MODEL_PJBL_PROJECT_BASID_LEARNING_DAL

[AM UPAYA MENINGKATKAN KREATIFITAS SISWA PADA KONSEP PENCEMARAN LINGKUNGAN DI MA N BABAKAN CIWARINGIN CIREBON#](#)

- Candiasa, I. M. (2010). *Statistik Univariat dan Bivariat disertai Aplikasi SPSS*. Singaraja: Undiksha Press.
- Dantes, Nyoman. (2008). Hakikat Asesmen Otentik Sebagai Penilaian Proses Dan Produk Dalam Pembelajaran Yang Berbasis Kompetensi. *Paper presented on In House Training (IHT) SMA N 1 Kuta Utara*.
- Dantes, N. (2012). *Metode Penelitian*. Yogyakarta: Andi Offset.
- Greenwald, N. (2001). Learning from Problems. *The Science Teacher*, 67(4) p. 28-32.
- Hasanah, U. (2016). Pengaruh Model Pembelajaran dan Kemampuan Berpikir Kritis Terhadap Hasil Belajar IPA Kelas V SD di Kelurahan Menteng, Jakarta Pusat. *Jurnal Pendidikan Dasar*, 7 (02) p. 387–398.
- Iman, Kartono, & Sugiono. (2013). Peningkatan Aktivitas Belajar Siswa Dalam Pembelajaran Ilmu Pengetahuan Alam Dengan Menggunakan Metode Demonstrasi. Research articles published by FKIP Universitas Tanjungpura
- Johnson, D.W. & Johnson, R.T. (2002). *Meaningful Assessment: A Manageable and Cooperative Process*. New York: A Pearson Education Company.
- Kamayani, I.A.D., Sumantri, M., & Sudana, D.N. (2013). Pengaruh Model Pembelajaran Project Based Learning Berbantuan Media Tiga Dimensi Terhadap Hasil Belajar IPA di SD Gugus IX Kecamatan Buleleng. *Mimbar PGSD Undiksha*, 1(1)
- Kiswanto, H., Sunarno, W., & Suparmi. (2016). Pembelajaran Berbasis Masalah Menggunakan Metode Proyek dan Eksperimen Ditinjau dari Kreativitas dan Kemampuan Berpikir Kritis Siswa. *Jurnal Inkuiri*, 5 (03) p. 57-65.
- Klein, J.I., Taveras, S., King, S.H., Commitante, A., Curties-Bey, L., & Stripling, B. (2009). *Project-Based Learning: Inspiring Middle School Students to Engage in Deep and Active Learning*. New Yorck: Department of Education.
- Kubiato, M. & Vaculova, I. (2011). Project-based learning: characteristic and the experiences with application in the science subjects. *Energy Education Science and Technology Part B: Social and Educational Studies*. 3 (1): 65-74
- Marhaeni, A.A.I.N. (2008). About Meaningfulness and Usefulness of Language Assessment. *Paper presented on the Regional Teflin Organization by the Faculty of Art, Udayana University, July 15th-16th*
- Mergendoller, J.R, & Thomas, J.W. (2001). *Managing Project Based Learning: Principles from the Field*. California: Handbook designed to help middle and high school teachers plan successful projects
- Payani, N.M.D. (2015). Pengaruh Model Pembelajaran Predict-Observe-Explain (POE) Terhadap Hasil Belajar IPA Ditinjau dari Keterampilan Berpikir Kritis pada Siswa Kelas V SD di Gugus I Kecamatan Gianyar. *Unpublished Thesis*. Program Studi Pendidikan Dasar Pascasarjana, Universitas Pendidikan Ganesha.
- Prayitno, W. (2010). Best practice: Implementasi project based learning dalam pembelajaran abad 21 pada mata pelajaran IPA kelas V SDN Jetis II Nglora kec. Saptosari, kb. Gunungkidul. *E-journal LPMP D.I. Yogyakarta*.
- Sastrika, I.A.K., Sadia, I.W., & Muderawan, I.W. (2013). Pengaruh model pembelajaran berbasis proyek terhadap pemahaman konsep kimia dan keterampilan berpikir kritis. *e-Journal Program Pascasarjana Undiksha*, 3 (01).

Suryabrata, S. (2001). *Psikologi Pendidikan*. Bandung: Angkasa.

Susilowati. (2013). Membelajarkan IPA dengan Integrative Science: Tinjauan kemampuan berpikir Kritis (critical thinking Skill) dalam Implementasinya pada kurikulum 2013. *Handout of Seminar Nasional Pendidikan IPA Universitas Negeri Malang*, 1 (51): 377-382.

Solihat, N. W., Halimah, L., & Yunansah, H. (2015). Pengaruh model project based learning terhadap hasil belajar peserta didik pada materi cuaca kelas III sekolah dasar. *Jurnal Antalogi UPI*, 1, 1-8.