Universitas Muhammadiyah Malang, East Java, Indonesia

JPBI (Jurnal Pendidikan Biologi Indonesia)

p-ISSN 2442-3750, e-ISSN 2537-6204 // Vol. 6 No. 1 March 2020, pp. 113-122

Research Article

Project-based learning model assisted by worksheet: It's effect on students' creativity and learning outcomes

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ARTICLE INFO

Article history
Received December 15, 2020
Revised February 25, 2020
Accepted March 15, 2020
Published March 31, 2020

Keywords
Biology learning outcomes
Creativity
Project-based learning
Science worksheet

ABSTRACT

The low factor of learning outcomes is triggering by the emergence of students' boredom in learning. This study aimed to determine the effect of Project-Based Learning (PjBL) Models assisted by the Science Worksheet on Applied Waste Management on students' creativity and learning outcomes. This research was a quasi-experimental study. The population was all students in Vocational High School 1 Cikedung, Indonesia, and the sample was 57 students from two classes. Learning outcomes data obtained through tests with multiple-choice questions while creativity data using response questionnaires. The data obtained were analyzed using a one-way analysis of covariance. The results showed there was a significant effect of the learning model on students' creativity and learning outcomes. It concluded that the PBL model assisted in the worksheet has a positive impact on student competencies, especially on their creativity and Applied Science learning outcomes.

How to cite: Suwarno, S., Wahidin, W., & Nur, S. H. (2019). Project-based learning model assisted by worksheet: It's effect on students' creativity and learning outcomes. *JPBI (Journal of Biological Education Indonesia)*, 6(1), 113-122. doi: https://doi.org/10.22219/jpbi.v6i1.10619

INTRODUCTION

The subject of Natural Sciences is needed to add knowledge, skills, attitudes, values, and responsibilities to the environment and society, but requires creativity as an achievement of the learning process. Applied science deals with innovation, not only mastery of the collection of knowledge in the form of facts, concepts, principles, complex thinking (Bilgin, Karakuyu, & Ay, 2015), and the process of discovery (Wijayati, Sumarni, & Supanti, 2019). While learning is expected to be a means for students to learn on their own and the natural surroundings (Astuti, 2015). Science education has an important role in producing quality human resources who are able to answer future challenges. However, the process of learning science still encounters problems and is not as expected. In principle, the subject of Applied natural sciences is used as a knowledge base to support the basic skills program of all Expertise Programs (Hanim, Suyanti, & Harahap, 2017; Lattimer & Riordan, 2011; Ulger, 2016). The benefits of Applied Science subjects are to provide a strong knowledge base and competitiveness of students to develop in their field of work.

Creativity in the 21st-century has an important role to improve the quality of education in all fields of learning including science, technology, engineering and mathematics as part of young people's education has increasingly been recognised (Bell, 2010; Shaheen, 2010; Wyse & Ferrari, 2015). Have this been achieved in the learning

process.The lack of students' creative thinking skills is due to the amount of learning that is anonymized only to improve cognitive abilities so that it still dominates in memory and thinking ability. Whereas in the psychomotor domain demonstrates the skills of reasoning, processing, and serving effectively, creatively, productively, critically, independently, collaboratively, communicatively, and solutically in the abstract realm related to the development of what they learn in school, and is able to carry out specific tasks under direct supervision. By using an appropriate learning model, students can optimize their creative thinking abilities (Kusumaningrum & Djukri, 2016; Zouganeli, Tyssø, Feng, Arnesen, & Kapetanovic, 2014). Bringing up creativity is a very good thing in learning, teachers are required to demonstrate and demonstrate the process of creativity (Wyse & Ferrari, 2015). Something that is universal and has a characteristic aspect of the world of life around us is creativity, creativity is characterized by the activity of creating something that did not exist before and was not done by someone or the tendency to create something (Du & Han, 2016).

Innovative learning centered on students, where the teacher as a motivator and facilitator becomes a necessity. Students are given the opportunity to work and build their knowledge. Nowadays, learning on the theme of handling waste is not very interesting when it is implemented in the classroom. This can be seen based on observational data, students generally get grades below 74. Where the minimum completeness criteria in schools is 74. The low learning outcome factor is triggered by the emergence of learning boredom, thus impacting on learning outcomes. To overcome these problems, learning creativity is needed. The implementation of the Project-Based Learning (PjBL) model, assisted by the Applied Science Worksheet, is one way to overcome the problem. The characteristics of Applied Science at the time of learning are the existence of contextual problems, the use of local materials, creative products, interesting products (Darling-Hammond, Flook, Cook-Harvey, Barron, & Osher, 2019; Shieh, 2014). Student worksheet applications can help improve students' basic competencies, be able to help teachers and students to play an active role, build knowledge, student performance in practicums, and project science (Putri, Rusdiana, & Suwarma, 2019; Suyatna & Manurung, 2017; Wulansari, Rusnayati, Saepuzaman, Karim, & Feranie, 2019).

Systematic teaching should involve students in learning knowledge and skills through research assignments, authentic questions, and well-designed products. The use of PjBL models will be better if it is based on challenging questions and makes students have a central role in design, problem solving, decision making processes so as to give students the opportunity to work relatively independently (Carnawi, Sudarmin, & Wijayati, 2017; Sumarni, 2015; Wijayati et al., 2019). The PjBL model provides opportunities for teachers to manage learning in the classroom by involving project work (activities). This project contains complex assignments based on very challenging questions and problems (Anazifa & Djukri, 2017), literacy skill (Suryandari, Sajidan, Rahardjo, Prasetyo, & Fatimah, 2018), and requires students to work through a series of stages of the scientific method (Lattimer & Riordan, 2011).

PjBL is usually considered a teaching approach in which students respond to real-world questions or challenges through a long process of inquiry (Chiang & Lee, 2016). PjBL organizes project learning by involving students in authentic situations where they can explore and apply subject matter to complex problems and relevant to the professional practice they are preparing (Lattimer & Riordan, 2011). PjBL in addition to producing works/products, was chosen because students learn actively, independently, and are involved in the real world. Students learn to innovate, apply creative thinking skills over a long period of time and always grow, moreover this learning is controlled by students and teachers only as facilitators. Student worksheets are used as a guide to achieving basic competencies. If basic competencies are oriented towards work based on the investigation, then project-based student worksheets are the right choice.

Some research results show that PjBL assisted by student worksheets can improve student creativity (Hanim et al., 2017; Nurisalfah, Fadiawati, & Jalmo, 2018; Putri et al., 2019; Wulansari et al., 2019), and improve student learning outcomes (Bilgin et al., 2015; Rahardjanto, Husamah, & Fauzi, 2019; Zouganeli et al., 2014). Based on the description, the purpose of this study is to determine the effect of the project-based learning model (PjBL) assisted by the Science Worksheet on Applied Waste Management on student creativity and learning outcomes.

METHOD

The research design used was Quasy-Experimental Design. The form of design used in this study is Nonequivalent Control Group Design. This design is almost the same as the Pretest-posttest Control Group Design Group, only in this design the experimental group and the control group are not randomly selected (Sugiyono, 2010). The study was conducted at Vocational High School 1 Cikedung Indramayu Regency, West Java Province-Indonesia with the population in this study were all X grade students of the Tourism Expertise Program in Hospitality Expertise Competencies consisting of two classes. The sample taken is hospitality expertise competency, because waste handling material is only available in that class. While the number of

samples is two classes, namely one experimental class with a total of 28 students and a control class of 29 students. The sampling technique used is the probability sampling.

The data collection method is the development of learning outcomes instruments in the form of multiple-choice written test of 20 questions, creativity using a one scoring rubric technique with a total of 10 items, while for student response data using a questionnaire of 20 statements. To get the quality of learning outcomes instruments, an instrument test is done through data analysis techniques by applying validity, reliability testing, difficulty levels, distinguishing features (Arikunto, 2014; Sugiyono, 2010). As for the validity test used is the product-moment correlation with valid results while the reliability using Cronbach's alpha formula technique with very high-reliability results.

The stages of the study began by observing the school, observing learning in the classroom which will be used as a sample class and seeing cognitive learning outcomes and skills. Next, make a plan by preparing a PjBL model of learning that is assisted by student worksheets for learning. Learning in the experimental class uses the project-based learning model with student worksheets assisted three meetings, while the control class applies conventional learning for three meetings. At the first meeting students in the experimental class and the pretest control class, and at the end of the second learning meeting the class was given a posttest. Creativity in this study, students were given the task of making solid waste treatment products into creative products according to their choice. Assignments given in groups are collected at the last meeting.

The syntax of PjBL models (Jones, 2019) assisted by the science worksheets that is applied to the experimental class includes; 1) Start with the essential questions; Students observe the basic forms of important questions related to waste management, 2) Designing Plans for Projects; Students together with their groups formulate problems and formulate hypotheses related to handling solid waste in the environment, 3) Make a schedule; Students together with the teacher collaborate to arrange a schedule of activities in completing the project, 4) Monitor students and project progress; The teacher is responsible for monitoring student activities when completing projects, 5) Assessing results; The teacher checks each group's work and provides feedback based on the work, 6) Evaluating experience; The teacher evaluates based on the results of the work. The control class applies a conventional model with stages: 1) Providing objectives, 2) Presenting information, 3) Checking understands and providing feedback, 4) Providing opportunities for further training.

After testing the instrument, it is followed by processing the prerequisite data analysis of the hypothesis test through the normality test with the Shaphiro-Wick test and the homogeneity test with the Livene test (Sugiyono, 2014). If both If both data are normally distributed and homogeneous variance then the hypothesis test is continued using one-way analysis of covariance (ANACOVA) to find out the magnitude of the increase in student learning outcomes.

As for knowing the dimensions of student creativity given assignments in groups were collected at the last meeting. The dimensions of creativity assessed include; fluency, flexibity, original, elaboration (Lucchiari, Sala, & Elide, 2018). To assess the process of making creative products resulting from the processing of solid waste, created in an instrument of creativity with a scoring based on the Thrustone scale and described in the form of categorization. As for the validity of the creativity instrument based on the results of the expert team's validation. As for knowing the categories of student creativity can be seen in Table 1.

Table 1. Category creativity product in soil wast treatment

Total Score	Belonging to the selected
21-30	Well
11-20	Enough
1-10	Less

Source: (Harpe, 2015).

RESULTS AND DISCUSSION

Student learning outcomes

Improved learning outcomes are taken from the data achievement scores for each item pretest and posttest. Achievement of the average score of pretest, posttest learning outcomes in the material handling of waste between the experimental class and the control class as shown in the Table 2.

Table 2. The average results of pretest and posttest

Class	Average	
	Pretest	Posttest
Experiment	64.82	78.04
Control	54.64	64.29

Based on Table 2 that the average increase in student learning outcomes in the material handling of solid waste in the experimental class and the control class. In the experimental class the category of increasing student learning outcomes is in the "medium" category, the increase factor is due to students being given more freedom in learning, constructing autonomous thinking, exploring reasoning power and actively communicating with groups in finding alternative solutions to problems that occur, while in the control class the category of improvement in student learning outcomes is in the "low" category, the factor is because freedom in learning is restricted, the teacher is still a factor of dominance in the class, the chance of students in constructing thinking, reasoning power, communication skills is limited.

There is a difference in student learning outcomes between the experimental class and the control class. The possibility of a significant influence because in learning activities in the form of problem solving and providing opportunities for students to work autonomously and construct their own learning, and produce a product of student work worth and realistic. Scientific approach and student-centered learning will make it easier for students to apply the knowledge they get in real situations, explore and elaborate the material being studied, while providing opportunities for students to actualize abilities through learning activities that are designed by the teacher (Farhana, Zakiah, & Azlina, 2019; Shieh, 2014). This also requires students to be more independent in learning, active participation occurs between students, collaborative learning skills in achieving academic abilities at a high level/taxonomy level of creativity.

As for the learning outcomes in the control class, there was no significant increase because this was more due to the learning aspects that were applied to the control class using conventional methods. The teacher explains only using verbal speech to class, while students only listen and take notes if there are concepts that are considered important. This causes students to be more passive because learning is more teacher center, even students will feel boredom, boredom, even minimal motivation to participate in learning if there is no student involvement in learning. Student creativity also does not appear, collaboration in learning is almost non-existent so this is what causes low learning outcomes in the control class (Carnawi et al., 2017; Sukarso, Widodo, Rochintaniawati, & Purwianingsih, 2019). explained that the application of the PjBL model assisted by student worksheets in science lessons can improve student learning activities and outcomes. In line with research conducted (Kusumaningrum & Djukri, 2016; Rahardjanto et al., 2019), that the provision of the application of the application of worksheets as teaching material in learning can improve learning outcomes, an increase occurs after experiencing the process of acceptance, processing, storage, and activation in the form of reinforcement and re-generation to be used. Based on the findings of the experts it was concluded that the application PBL models assisted by the science worksheet could increase the activity of student learning outcomes both aspects (Fini, Awadallah, Parast, & Abu-lebdeh, 2017), cognitive, and psychomotor (Suyatna & Manurung, 2017; Usmeldi, 2019). Because student learning is stimulated with fundamental questions, designing project designs together, students are given the freedom to explore abilities and develop their creativity so that in this study an increase in student learning and creativity results.

Student creativity in experimental classes

There are two research creativity data, the first is a description of the total value of each group's creativity and achievement categories and a description of the percentage of students' creativity (each group) using Thrustone scale scoring and interpretation, as shown in Figure 1 and Figure 2. While the second is describe the percentage of each indicator shown in Figure 3.

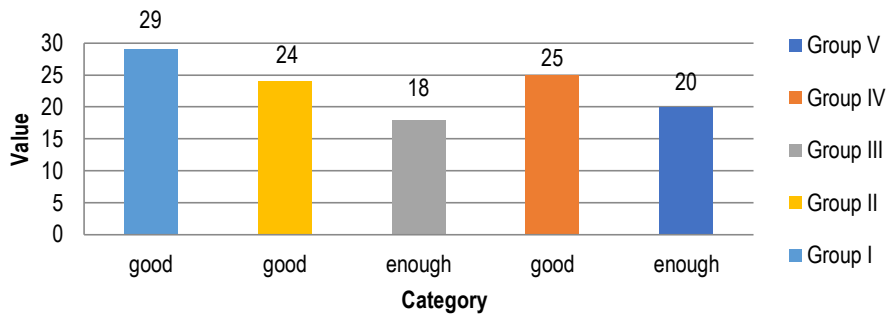


Figure 1. The diagram of total value and category achievement student creativity in experimental class

Based on Figure 1, that the highest total value is achieved by the 1st group with a score of 29 with good category interpretation, the dimension of student creativity in designing the product, generating relevant answers in making the product, and sparking many suggestions in problem-solving. The flexibility dimension analyzes the

type of material used, managing the results of solid waste by applying properties in problem-solving. The dimension of originality creates products by generating renewable ideas, unusual combinations of parts or elements of materials, giving a new idea in solving solid waste. The elaboration dimension develops people's ideas by combining creative ideas. While the lowest total value and creativity achievement are achieved by the 3rd group with a score of 18, where on average each dimension has sufficient category interpretation, except the flexibility category analyzes the type of material used and the originality category makes the product by bringing up renewable ideas having less interpretation. Originality in making products will bring up ideas that can be updated, this indicator is expected to bring up the ability to explore a variety of relevant sources independently (Astuti, 2015; Siew & Ambo, 2018).

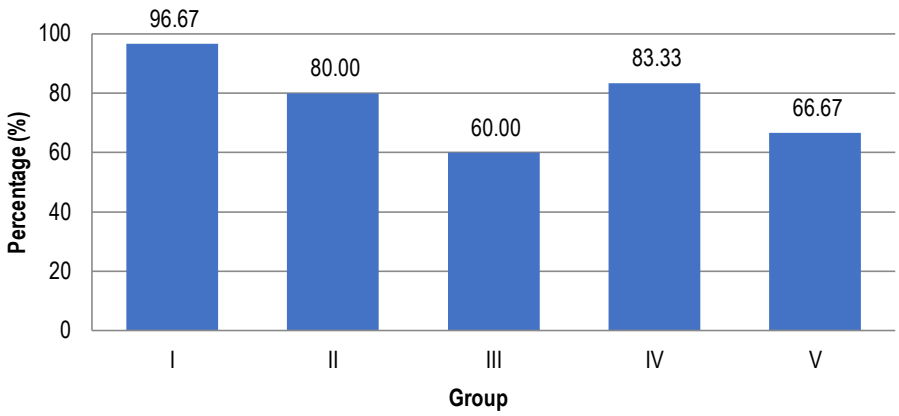


Figure 2. The diagram of percentage of each group class student creativity experiment

Based on Figure 2, that the total value of creativity if presented that gets the highest score is the 1st group with a percentage value of 96.67%, where the distribution of the average achievement of each dimension of fluency, flexibility, originality, elaboration with good interpretation. The group I creativity product is a paper samba mask. While the lowest percentage of total value is in the III group with a percentage of 60% distribution of the average achievement of each dimension with sufficient interpretation, namely with creativity products in the form of decorative lamps from cardboard. From the description of Figure 1 and Figure 2 it can be concluded that the implementation of PBL models assisted by the science worksheet can bring out the creativity of students in designing products and produce answers that are relevant in making products (Anggani, Bharati, & Lestari, 2019; Putri et al., 2019; Sahida & Zarvianti, 2019).

The description of the results of the data processing of the creativity of the experimental class students of each indicator in making learning media for student worksheets with the PBL model can be seen in the illustration in Figure 3.

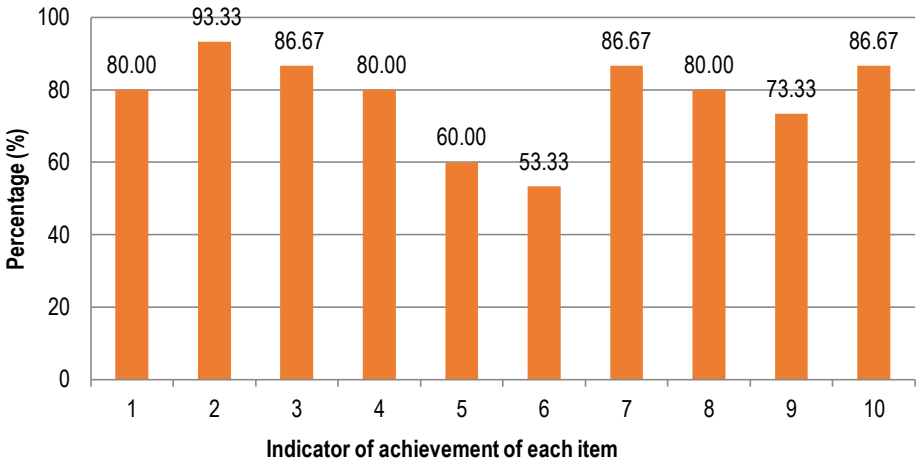


Figure 3. The diagram of indicator percentage of each student creativity experiment class

Based on Figure 3 that the highest percentage value is on the second indicator of fluency dimension with a result of 93.33%, on the second indicator students on average each creative group generates many answers (combining materials, using water/oil paint, varnish) that are relevant in manufacturing products. The next highest percentage is indicators 3, 7, and 10. In the 3rd indicator the students' fluency at this stage creatively triggers many suggestions (pattern making, product shape) on solving the relevant problems in making products. On the 7th indicator of originality based on the final results of the project that has been done, students make products with various unusual combinations of parts or elements of material (paper, wood, plywood, cans, banana fronds). Whereas in the 10th elaboration indicator, the students' creativity explains the results of their work well through feedback on the appropriate stages in PBL models assisted by the science worksheet, at this stage students are able to make reports in detail, detail, and appear different. Still with the highest percentage, namely indicators 1, 4, and 8. Indicator 1 of the fluency dimensions of students designing solid waste products by bringing up (artistic value) many ideas and ideas at the time of manufacture. The fourth indicator of the flexibility dimension of this stage students analyze the problem of the type of material (seen from thickness, tenacity, artistic value) used in managing solid waste products into creative products and following the instructions given by the teacher. While on the 8th indicator of the originality dimension students give new ideas in solving solid waste problems, by making products that are more creative and innovative.

The next percentage is the 9th indicator of elaboration students develop or enrich people's ideas by combining ideas and creative ideas. The 5th percentage indicator is the originality indicator of students managing the results of solid waste by applying properties (physical, chemical, biological) or rules in problem solving. The lowest percentage indicator is the 6th indicator of the originality dimension of 53.33%, in this indicator low creative students manage the results of solid waste by applying properties (physical, chemical, biological) or rules in problem solving. Assessment of student creativity is taken from the results of solid waste products by implementing PBL models assisted by science worksheet given in groups.

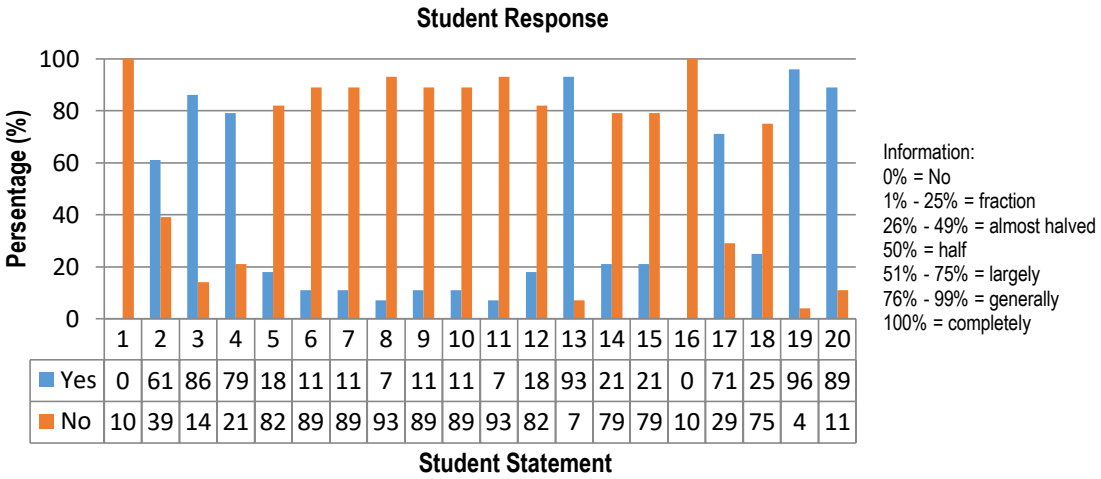
PBL models are assisted by science worksheets created and applied in the experimental class while learning. Overall shows a positive influence on student creativity and has good grades. This can be seen from each dimension, the dimension of fluency with three existing indicators, where all three get good results, this shows that students are able to do practical work and finish it well in designing creative products. The dimension of the flexibility of the two indicators obtained, there is one indicator value which is not optimal. There are various reasons why creativity does not emerge, and most do not focus on the teacher, for example; administrative pressure, and some basic mismatch between creativity and the school environment (Runco, Acar, & Cayirdag, 2017). Therefore, a teacher must be creative, able to motivate and give more attention in the implementation of PBL, and schools must also support (King & Smith, 2020; Wijayati et al., 2019).

The dimension of the flexibility of good creativity in the field of management of solid waste products into creative products by looking at problems from a variety of different perspectives. As for the dimension of originality, two indicators with good results, namely students are able to make products with various unusual combinations of various elements, but one indicator that produces renewable ideas is not optimal so that it only has enough value, this can occur because students are rarely given the opportunity and challenge to answer questions with varied answers. Low assignment scores can be influenced by the results of the same project work (Gunawan, Sahidu, Harjono, & Suranti, 2017). While the elaboration dimension gets good results, this can be seen from the indicators of students who develop or enrich people's ideas by combining creative ideas and ideas, as well as indicators of students making reports in detail, detail, and appear different. The application of PBL models in learning will require students to be more creative in carrying out activities (Isabekov & Sadyrova, 2018). High-quality group work becomes more important when group members show positive interdependence, individual accountability, equal participation (Kokotsaki, Menzies, & Wiggins, 2016). Supportive atmosphere and conducive to the development of many original responses from a broader perspective can be done if group members provide new ideas and opinions that support one another (Siew & Ambo, 2018).

PjBL requires a commitment of more resources than traditional, lecture-based or discussion-based learning. Using the worksheet, might assist the initial thinking when deciding to implement a PBL. The results of the study Gunawan et al., (2017); Surya, Relmasira, & Hardini, (2018) show that the application of the PBL model encourages students to be more creative. Involved in solving problems that suddenly occur and encourages students to be able to find alternative solutions (Safitri & Suparwoto, 2018). Using science worksheet is one of the learning tools to help students learn in a directed manner and in accordance with the learning objectives to be achieved. From the findings of the experts it is concluded that the application of the PBL model encourages students to be more creative, and the application of student worksheets helps students learn in a directed manner. The connection of findings with the implementation of the PBL models are assisted by science worksheets that have done the results can open space for students to be more creative involved in solving problems, able to find alternatives to problems and develop or enrich people's ideas by combining ideas and ideas.

Student learning responses, using the PjBL models assisted by the Science Worksheet

Description of questionnaire data processing responses of experimental class students to learning by making and using PjBL models assisted by the science worksheet on solid waste handling material can be seen in Figure 4.



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Yes	0	61	86	79	18	11	11	7	11	11	7	18	93	21	21	0	71	25	96	89
No	10	39	14	21	82	89	89	93	89	89	93	82	7	79	79	10	29	75	4	11

Figure 4. Bar chart student learning responses, using the PjBL models assisted by the science worksheet

Based on Figure 4 which has an interpretation of 100% consisting of two statements, namely the 1st statement "never learned by applying the PBL model supported by science worksheets", the 16th statement "there have never been other subjects applying PBL models that assisted by science worksheets". While those who have an interpretation of 76%-99% are 15th statements, 3rd statements "students are helped in learning, 4th statements" before learning, find it difficult to solve questions about waste management, 5th statement "no longer having difficulty completing questions given about waste handling materials ". The teacher is in charge as a facilitator and students at the learning center. Thus students will be more free in expressing their ideas and thoughts into work based on reality (Ismuwardani, Nuryatin, & Doyin, 2019). Based on the 6th Statement explaining "can help explore and develop creativity", the 7th statement explains "more working with group members, the 8th statement" can make the Project better. "Project-based learning not only increases motivation, learning, vocational training, and facilitating students' problem solving abilities (Bilgin et al., 2015; Chiang & Lee, 2016). To achieve this requires collaboration, PBL usually asks students to voluntarily participate in meaningful learning activities that are proposed, mostly teamwork (Bédard, Dalle, & Boutin, 2012).

Based on the 9th Statement, the results explain "students can exchange positive opinions with friends", the 10th statement "can motivate students to learn". Students are responsible for their own learning and knowledge. When they are asked to give advice, they show a deep insight into the enthusiastic learning process (Zouganeli et al., 2014). while the 11th Statement explains "suitable to be applied to waste handling materials", the 12th statement "there is no difficulty when completing the Applied Science assignment", the 13th statement "actively seeking information/their own literature", 14th statement "does not require much time", the 15th statement "does not require much energy and cost", the 19th statement "is more active and focused on project work", and the 20th statement "students are more free of expression". As for other advantages, the PBL model is assisted by science worksheets that indirectly improve communication skills and student motivation (Anazifa & Djukri, 2017; Zouganeli et al., 2014), problem solving skills increase, train students' ability to manage projects well (Bédard et al., 2012), natural collaboration occurs between students (Gralewski & Karwowski, 2012; Jones, 2019; Ravitz, 2010), improve skills in managing various sources (Du & Han, 2016), learn from real experience (Lattimer & Riordan, 2011). The PjBL model is directed at making students learn from real experience, enhancing skills in time management (Wijayati et al., 2019).

Whereas student responses 51%-75% consist of three statements; namely the 2nd statement "science learning activities are more enjoyable", the 17th statement "needs to be applied to other subjects", and the 18th statement "students lack understanding of what is is being done in working on the project". From the description of statements about students' responses to learning that implements the PBL model assisted by the student worksheet, it is known that positive responses are more numerous than negative responses, this is because it has never been applied before and not many other subjects apply it (Yuniarti, Susanto, & Irvan, 2018). One of the strengths that characterize PBL can be applied to different levels of education and its versatility with various fields of knowledge (Cabedo, Guraya, Lopes-crespo, Royo, & Gomez-Perez, 2015; Ravitz, 2010).

CONCLUSION

Based on this study, the effect of the PjBL model assisted by science worksheets on student creativity and learning outcomes. The results showed that there were significant differences between the experimental class and the control class. In addition, students' respond about implementing the PjBL model assisted by science worksheets received positive responses. There are several things the authors suggest in applying this model, namely the need for good planning and preparation, reviewing the suitability of the material, class time management. The results need to be developed in future research to fully understand individual activities and their long-term impacts.

ACKNOWLODGMENT

High appreciation was conveyed to the Director of the Graduate School, University of Kuningan, who has given permission and facilitated this research. The Head of the Graduate School Program, University of Kuningan, as well as the Guidance and Study Team who have directed the research well.

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