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The Effect of Project Based Learning (PjBL) Model on Students' Science Literacy in Social Studies Subjects

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Abstract

This study aims to analyze the effect of the project-based learning (PjBL) model on students' scientific literacy and to describe the effect of the PjBL model on students' scientific literacy in Social Science subjects with the theme of fire disaster mitigation in residential areas. The research design used in this study is a one-group pretest-posttest design using a quantitative approach the population is 496 students, and the sample size is 60 students with a purposive sampling technique. The location of this research is SMK Negeri 1 Lamongan. The data collection technique in this study used a scientific literacy test and an observation sheet on the implementation of learning then the data analysis technique applied in this study used a feasibility test of learning instruments and tools, namely the Lesson Plan (RPP) validation test, Student Worksheet (LKPD), and scientific literacy test, then a prerequisite test was carried out namely normality, and homogeneity tests were then tested using a paired sample t-test to measure students' scientific literacy and to measure learning implementation sheets using learning implementation analysis. The results of this study shows that (1) the implementation of learning in lesson plans using PjBL is in the very good category with an average of 91.19%; (2) PjBL model has significant effect on students' scientific literacy ($p < 0.05$). Therefore, it can be concluded that there is a significant effect between the PjBL model on students' scientific literacy and the implementation of RPP using the PjBL model is in the very good category.

Keywords: PjBL; Science Literacy; Student Response; Learning Implementation

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INTRODUCTION

Natural and Social Sciences (IPAS) subjects serve to equip students to solve real-life problems in the 21st century related to natural and social phenomena around them scientifically by applying scientific concepts (Raehanah et al., 2020). An explanation of the phenomena of natural disasters that occur in the surrounding environment can be seen from various aspects, such as living things and their environment. Students also relate natural disaster phenomena to technical skills in their expertise, such as explaining natural disaster mitigation (Nuri et al., 2021). Disaster mitigation is a series of efforts to reduce disaster risk through physical development and awareness and capacity building in dealing with disaster threats. Mitigation of natural disasters is the community's responsibility; overcoming it requires the cooperation of all citizens. All citizens must have specific competencies to implement natural disaster mitigation in

their environment. Thus, there is a need for a renewal called scientific literacy in formal and informal education (Liu, 2009).

Scientific literacy is a person's ability to understand science, communicate science (oral or written) and apply scientific knowledge to solve problems so that they have a high attitude and sensitivity to themselves and their environment in making decisions based on scient ific considerations (Srigati, 2020). Scientific literacy is one of the essential abilities that is measured to illustrate how successful the education curriculum in Indonesia is (Kemdikbud, 2017). One of the international assessments to measure scientific literacy is the Program for International Student Assessment (PISA). The Program for International Student Assessment (PISA) is an international assessment program coordinated by the Organization for Economic Cooperation and Development (OECD). The Organization for Economic Cooperation and Development (OECD) report shows that in 2012 Indonesia's scientific literacy was ranked 64 out of 65 countries with a score of 375 (OECD, 2014). In the 2015 PISA, Indonesia was ranked 62 out of 72 countries with a score of 403 (OECD, 2015). At the 2018 PISA, Indonesia was ranked 70th out of 78 countries with a score of 396 (OECD, 2019). PISA with a score of 403. These results indicate that the scientific literacy ability of Indonesian students is still considered low and is one of the problems of education in Indonesia (Rohman et al., 2017).

Indonesian students' low scientific literacy ability is caused by many things, namely the education system, curriculum, learning models and methods, learning resources, and teaching materials that have not been supported to improve scientific literacy skills. The results of interviews conducted at the SMK Negeri 1 Lamongan with the Civil Service teacher for the IPAS subject on November 15, 2021, information was obtained that the teacher applied Discovery Learning and had not integrated it in the stages of the learning model that was able to improve scientific literacy skills. Such learning cannot provide provisions for students as community candidates to have competence in solving everyday problems related to the environment, technology, social and economy (Widiana et al., 2020). To overcome these problems, there is one innovative learning model that can be applied to students, namely the project-based learning (PjBL) model.

The PjBL model is a learning process that directly involves students to produce a project. Basically, this learning model develops problem-solving skills in working on a project that can produce something (Apriany et al., 2020). The advantages of the project-based learning model are that it can increase student motivation, problem-solving skills and cooperative attitudes, and resource management skills. The project-based learning process can make it easier for students to understand the material because they immediately apply their knowledge to a project they arrange. The project will make it easier for students to remember the concepts that have been obtained (Hayati et al., 2013).

Based on the explanation above, the advantages or advantages of the Project Based Learning (PjBL) model above, the reason for using this learning model is because the science subjects are new and deserve to be studied in accordance with initial discussions with teachers at SMK Negeri 1 Lamongan stated that the output of this learning is in the form of a project because students are expected to understand scientific knowledge and apply it in life and make predictions with proof. So that researchers are interested in using the Project Based Learning (PjBL) learning model. In addition, the PjBL learning model applied in fire disaster mitigation materials in

settlements has never been carried out. However, the application of the Project Based Learning learning model still needs to be researched to determine whether there is an influenceon the application of the model. Based on the description above, research was conducted with the formulation of the problem that arises is how is the implementation of learning using the PjBL model? How does the PjBL model affect students' scientific literacy in Social Science subjects with the theme of fire disaster mitigation in residential areas?

The purpose of the current research was to determine the effect of the PjBL model on students' scientific literacy in Social Science subjects with the theme of fire disaster mitigation in residential areas. The impact of the PjBL model on the context of students' literacy was obtained by some researchers. The relevant research is the result of (Pelger & Nilsson, 2016) research, which suggests that scientific literacy in 64 students can be significantly increased from the perspective and understanding of problems through the project of writing popular scientific papers in the field of biology. Another study from (Wong et al., 2021) found that PjBL with digital technology increased critical literacy in science students. Another relevant study from (Karpudewan et al., 2016) suggests that PjBL has a greater impact on student literacy in terms of cognitive, affective, and psychomotor aspects than more traditional energy conservation learning models. The research conducted by this researcher is distinct and novel in comparison to the three relevant studies mentioned above, owing to (1) the incorporation of digital technology that students can access at any time and from any location to hone students' abilities in finding credible literature; (2) the use of a previously unstudied topic of residential fire disaster mitigation in social science learning; and (3) the levels and curriculum used in research subjects aspects that contributed to the study's success.

METHOD

The researcher uses a quantitative approach because this study uses a population or sample by purposive sampling, collecting data using predetermined instruments, and analyzing data to test a theory, show a certain variable, and make a hypothesis. The research design used in this study was a one group pretest-posttest design. This research is located at SMK Negeri 1 Lamongan. Meanwhile, the implementation time of this research is in the even semester of April-June for the 2021/2022 academic year. The population in this study were all students of class X, even semester of SMK Negeri 1 Lamongan, with a total number of students as many as 496 students. The research samples are 33 students in class X Hospitality 2 (Class A) and 27 students in class X Culinary 2 (Class B), chosen by purposive sample technique.

Table 1. Sample Description

Class	Total Students	Age Range	Gender	
			Male	Female
X PH 2	33	15-16 Year	17	16
X KL 2	27	15-16 Year	2	25

Data collection techniques used in this study were pretest-posttest and observation. Pretest and posttest were used to determine students' level of understanding and knowledge of scientific literacy. Observation was used to obtain data on the implementation of learning using the PJBL model. This study uses 4 data

analysis techniques: (1) Feasibility test of learning instruments and tools. This test consists of scientific literacy test instruments and Learning Implementation Plans (RPP), and Student Worksheets (LKPD); (2) Prerequisite test is divided into 2, namely the normality test and homogeneity test; (3) The analysis of the implementation of learning will be obtained from the results of the assessment on the observation sheet on the implementation of the lesson plans; (4) Hypothesis testing, namely the T-test, was used to determine the effect of the Project Based Learning (PJBL) model on students' scientific literacy. In this research, a paired sample t-test was used, which was analyzed using the SPSS version 26.0 program for windows.

RESULTS AND DISCUSSION

Feasibility Test of Learning Instruments and Tools

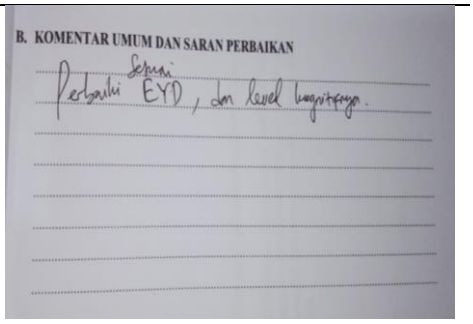
Before the researcher conducted the instrument test, the researcher first conducted a validation test by an expert. A validation test was carried out to find out the research instruments used had met the requirements and were suitable for use as data collectors. An instrument is said to be valid if it can measure what is desired. An instrument is said to be valid if it can reveal data from the variables studied appropriately. The high and low validity shows the extent to which the data collected does not deviate from the intended validity picture (Monika et al., 2018). Science Education Lecturers carried out this validation test, namely Mr. MH and Mr. AS as material experts. The analysis of the feasibility test of the instrument in this study used the help of Microsoft Excel. The validity results are discussed in the description below.

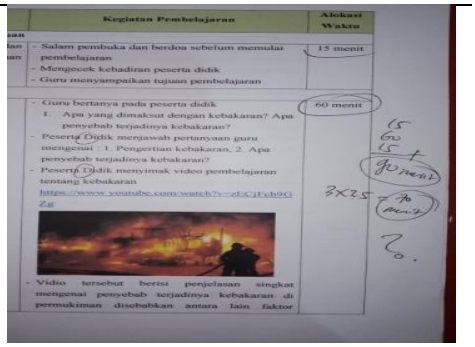
Table 2. Validation Result

	Percentage (%)	Category
RPP	96.06	Very Valid
LKPD	92.00	Very Valid
Student Science Literacy Test	93.00	Very Valid

Based on Table 2, it can be seen that the validation results of the scientific literacy test instrument are 93%, RPP 96.06%, and LKPD 92%. This means that scientific literacy instruments and learning tools are included in the very valid category. If the validation results are very valid, the lesson plan is feasible to be used as a research data collector. If the validation results are not valid, then the lesson plans are unsuitable for research data collectors. However, there are some notes and suggestions contained in Table 3.

Table 3. Results and Suggestions

No	Suggestions/Notes	Repair	Picture
1.	The scientific literacy test still needs to be corrected with good and correct language rules in accordance with the improved spelling (EYD).	It has been fixed regarding the rules of good and correct language according to the improved spelling (EYD)	

No	Suggestions/Notes	Repair	Picture
2.	RPP still needs to be improved regarding the allocation of learning time.	Fixed the division of learning time allocation	
3.	The LKPD still needs to be improved to make it more attractive.	It has been fixed regarding the appearance of the LKPD to make it more attractive	

Prerequisite Test

Normality test

A normality test was conducted to determine whether the results of the pretest and posttest studied were normally distributed. Statistically, this normality test can be done using expore analysis and the significance value in the Shapiro-Wilk column. Shapiro-Wilk is a method used to process small sample data. The analysis technique uses the formula if the probability value of sig 0.05, then the data distribution is normal, and if the probability value sig <0.05, then the data distribution is not normal.

Table 4. Data normality test results

Group	Pre-test			Post-test		
	Statistic	df	Sig.	Statistic	df	Sig.
Class A	.933	27	.082	.930	27	.067
Class B	.941	27	.128	.927	27	.058

Table 4 shows that the results of the normality test of the pretest data with sig probabilities for Class A and Class B are 0.082 and 0.128. Thus, the pretest was normally distributed, so that the data analysis used parametric statistical analysis. The posttest data normality test result also found with a sig probability of Class A and Class B of 0.067 and 0.058. Thus, the posttest is normally distributed, so that data analysis uses parametric statistical analysis.

Homogeneity Test

A homogeneity test was conducted to assume that the research sample departed from the same conditions. If the significance value of sig < 0.05, the data does not have a homogeneous variance and if the significance value of sig > 0.05 means that the data has a homogeneous variance.

Tabel 5. Data homogeneity test results

Group		Levene Statistic	df1	df2	Sig.
Pretest	Based on Mean	.762	1	52	.387
	Based on Median	.435	1	52	.512
	Based on Median and with adjusted df	.435	1	49.173	.513
	Based on trimmed mean	.732	1	52	.396
Posttest	Based on Mean	.097	1	52	.757
	Based on Median	.016	1	52	.900
	Based on Median and with adjusted df	.016	1	51.908	.900
	Based on trimmed mean	.071	1	52	.791

Table 5 shows that the results of the homogeneity test of the pretest data are with a significance value of 0.387 or 0.387 > 0.05. Thus, the pretest data has a homogeneous variance. For the posttest data, it can be seen that the results of the homogeneity test has a significance value of 0.757 or 0.757 > 0.05. Thus, the Posttest data has a homogeneous variance.

Learning Implementation Analysis

Two observers observed the implementation of learning using Project Based Learning (PjBL) model was observed by 2 (two) observers, namely, UNISLA Science Education Students and Science Education Teachers, were analyzed. Observations were made on the activities of teachers and students from the beginning to the end of the teaching and learning process. The observer puts a checklist mark (√) in the prepared assessment score column.

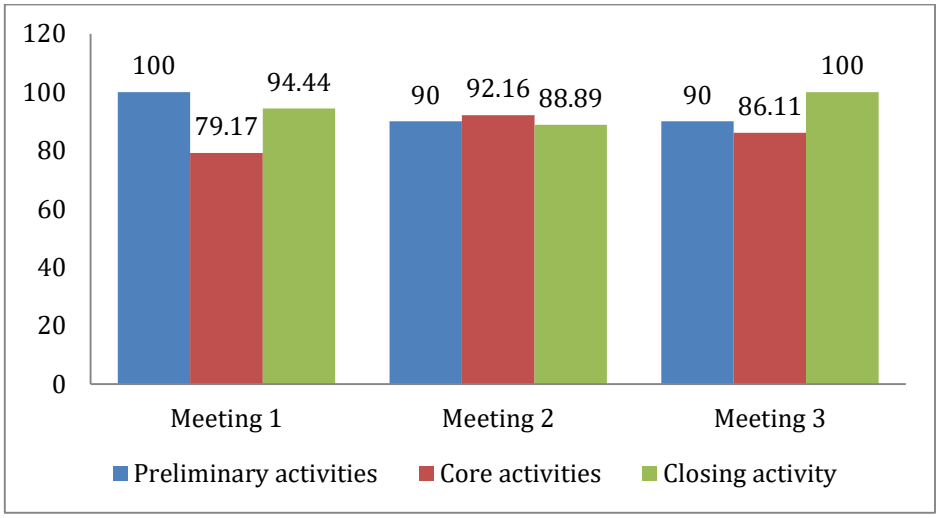


Figure 1. Learning Implementation Results

On the implementation sheet of student learning with the Project Based Learning method, the average percentage of students who carried out and was appropriate at the time of the introduction was 93.33%, and during the core activity was 85.81%, while at the closing time it was 94.44%. So the overall average of learning implementation is 91.19%, which means P > 75% or 91.19% > 75% which is included in the very good category. The implementation of learning (RPP) with the PjBL learning model can be seen from the percentage of implementation which is stated

with the criteria implemented and not implemented. The implementation of the learning is also assessed to determine whether the implementation of the learning is categorized as very good, good, not good or not good. Judging from the percentage of learning implementation (RPP), figure shows the results of observations regarding the implementation of learning.

Based on previous research, implementing this excellent learning supports student activities So that the implementation of excellent learning can increase student activity. Student activities in learning by applying the PjBL model achieved a 100% implementation percentage with an achievement value of 77.08. Thus, the implementation of learning will also affect student learning outcomes to increase (Indahwati & Abdullah, 2019; Muhali et al., 2021).

There is a positive relationship between the implementation of learning and student motivation (Ratih, 2017). This means that if the implementation of learning is done very well, it will motivate students and increase their interest in learning because the learning is very interesting and motivating so that students do not feel bored while doing learning activities. Based on previous research, the implementation of learning very well can improve students' creative thinking skills, this is in line with the results of research conducted by (Naswir et al., 2017) the results of the study stated that the implementation of the guided inquiry learning model had a positive effect on the colligative properties of the solution in the material. class XII IPA 1 on students' creative thinking skills.

Based on the findings of this research data analysis, it supports the research from (Muzana et al., 2021) namely that project-based learning can be facilitated through various media that allow not only media brought by the teacher (offline), but also digital technology media during learning. At every learning meeting, teachers and students interact to create a conducive learning environment and ensure that the project results initiated can be successfully completed. The teacher must be the initiator and facilitator in developing ideas or ideas that students have that can be used as a project to solve problems they face (Li et al., 2021). Each student has the same opportunity to express ideas, opinions, and participate in problem-solving groups or directly in class forums.

Projects completed during PjBL learning must also be evaluated; evaluations can be performed by project creators, fellow students, and teachers to improve the quality of the projects being completed (Kovácsné Pusztai, 2021). Evaluations conducted during learning are constructive and mutually supportive, with the assistance of in-depth analyses conducted by peers, because it is common for students to still require input and assistance in deciding which projects to work on and the methods used at each stage.

Hypothesis test

Paired Sample T-test

The hypotheses proposed in this study are:

Ha : There is a significant effect between learning with project based learning (PjBL) models on students' science literacy in Social Science subjects with the theme of fire disaster mitigation in residential areas.

H_0: There is no significant effect between learning with project based learning (PjBL) models on students' science literacy in Social Science subjects with the theme of fire disaster mitigation in residential areas.

After analyzing the data using the paired samples T test, the results of hypothesis test presented in Table 6.

Table 6. Paired sample t-test result

Pair	Test	Mean	SD	t	df	Sig.
Pair 1	Pretest - Posttest	-30.046	6.738	-32.769	53	.000

Calculation of the hypothesis by looking at the criteria Ho is accepted if the significance level > 0.05 then the X variable has no effect on the Y variable, and Ha is rejected if the significance level is < 0.05 then the X variable has an influence on the Y variable. Based on the data above, it can be seen that significant (2 tailed) of 0.000 or 0.000 <0.05. This means that Ha is accepted and Ho is rejected or there is a significant influence between learning and the project-based learning (PjBL) model on students' scientific literacy in Social Science subjects with the theme of fire disaster mitigation in residential areas.

Based on the data in table 8, it can be seen that the significance value of the results of the paired sample t-test is 0.000 or 0.000 <0.05. This means that Ha is accepted and Ho is rejected or there is a significant influence between learning with the project based learning (PjBL) model on students' scientific literacy in Social Science subjects with the theme of fire disaster mitigation in residential areas. Meanwhile, based on table 4.8, it can be seen that the average pretest score for class A is 51.53 and for class B is 51.57. The average value of the pretest shows that the students' initial scientific literacy skills between Class A and Class B are not that far apart. After each class was given treatment, there was an increase in scientific literacy in both classes. For class A, there was an increase in scientific literacy by 29.44% with an average posttest score of 80.97 and the increase was in the moderate category. Meanwhile, for class B, there was an increase in scientific literacy by 30.00% with an average posttest score of 81.57 and the increase was included in the Medium category.

The results of testing the overall hypothesis that have been described previously show that the project-based learning model is proven to have an influence on students' scientific literacy. The project based learning learning model can affect students' scientific literacy, because in the learning process they are trained to improve students' scientific literacy, starting from giving ideas, and also in the process of working on LKPD in groups they have the same problems so that students can correct each other when the presentation takes place, and be seen when the process of making a project until they can finally finish it and answers from students when presenting about the project they made.

The results of previous studies also state that the use of the PjBL model is in accordance with the ideal learning components for students. By selecting a strategy design that can be adapted to classroom conditions, teachers can accommodate the various abilities of students at school (Astawa et al., 2015). The results of another study are the same which states that the scientific literacy ability of students who receive PjBL learning assisted by a scientific literacy module is better than students who receive lecture learning accompanied by experiments and use teaching materials commonly used in schools (Sari et al., 2017).

Other studies also state that the PjBL learning model has an effect on students' scientific literacy, this can be seen from the significant difference between the experimental class and the control class, where scientific literacy, creativity and learning outcomes in the experimental class are better than the control class. thus the

PjBL STEM model has an influence on scientific literacy, creativity and student learning outcomes at SMAN 11 Sinjai (Lutfi et al., 2018).

Another study also explained that the use of the project-based learning model (PjBL) was appropriate or had a positive effect on increasing students' scientific literacy. This can be seen from the results of the analysis of the scientific literacy ability test which showed that students who received project learning assisted by a scientific literacy module had higher literacy skills than students who received lecture learning accompanied by experiments and used teaching materials commonly used in schools (Aksela & Haatainen, 2019).

Learning using the PjBL learning model also increases student literacy. This increase can be seen in the scientific literacy indicators. The first indicator regarding the identification of valid scientific arguments has increased from 51.33 to 76.14. The second indicator, namely the evaluation of the validity of the source, also increased from 46.21 to 76.21. The third scientific literacy indicator, namely reading and interpreting graphical representations of data, also increased from 53.22 to 76.14. The fourth scientific literacy indicator, namely solving problems using quantitative skills including probability and statistics, also increased from 48.49 to 78.41. The fifth indicator, namely understanding and interpreting basic statistics, also increased from 56.44 to 82.58. The increase can be seen in the following diagram:

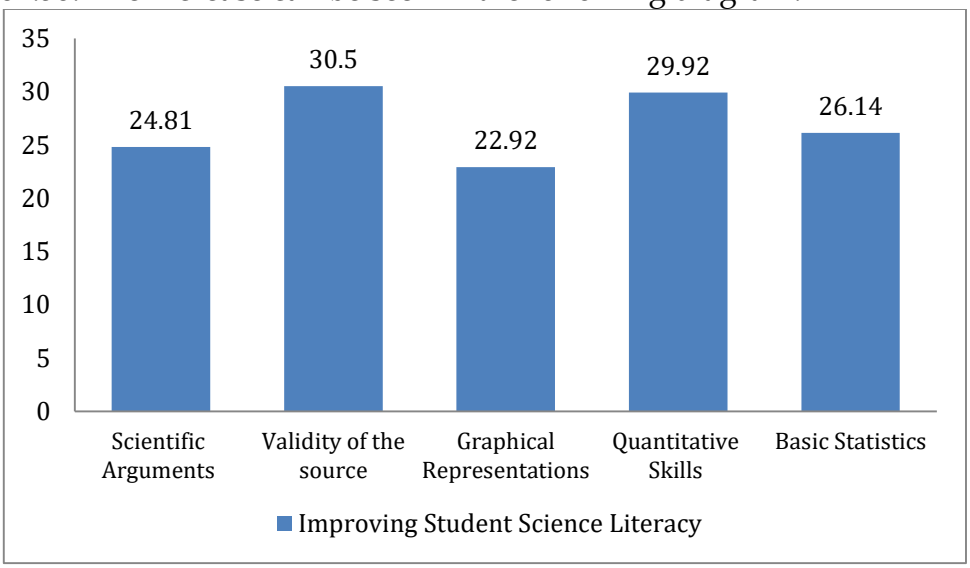


Figure 2. Results of Improved Student Scientific Literacy

Project-based learning can be concluded that students have an awareness of the importance of scientific literacy and are able to develop 21st century skills which are reflected in the PjBL learning model indicators that appear during learning such as scientific skills, problem solving, have the ability to deal with problems in the real world, collaborate and communicate information. The use of project-based learning models is expected to be able to produce competitive and calculated students in the real world in the future.

CONCLUSION

Based on the results of observations that the implementation of learning in the RPP using the Project Based Learning (PjBL) learning model is in the very good category with an overall average implementation in the RPP of 91.19%. Based on the hypothesis test that there is a significant effect between learning with the project based

learning (PjBL) model on students' scientific literacy in Social Science subjects with the theme of fire disaster mitigation in residential areas, the significance of the results from the paired sample t-test is 0.000 < 0.05 .

RECOMMENDATION

Several suggestions were put forward related to the research that had been done, namely, first, learning in schools should train students' independent learning by using student-centered learning models, such as PjBL. However, teachers must also improve the assessment of learning outcomes by developing scientific literacy questions. Students must be familiarized with questions that have a framework, such as the PISA questions. Second, it is hoped that there will be research involving collaboration with other subjects that support the achievement of higher scientific literacy.

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DECLARATION OF INTEREST

There are no conflicts of interest declared by the authors.

REFERENCES

Aksela, M., & Haatainen, O. (2019). Project-Based Learning (PBL) in Practise: International STEM in Education Conference. *Integrated Education for the Real World*, 9–16.

Apriany, W. A., Winarni, E. W., & Muktadir, A. M. (2020). Pengaruh Penerapan Model Pembelajaran Project Based Learning (PJBL) terhadap Hasil Belajar Kognitif Siswa pada Mata Pelajaran IPA di Kelas V SD Negeri 5 Kota Bengkulu. *Jurnal Pembelajaran Dan Pengajaran Pendidikan Dasar*, *3*(1), 88–97. https://doi.org/10.33369/dikdas.v3i1.12308

Astawa, I. M. W., Sadia, I. W., & I Wayan, S. (2015). Pengaruh Model Pembelajaran Berbasis Proyek Terhadap Sikap Ilmiah Dan Konsep Diri Siswa SMP. *Jurnal Pendidikan Dan Pembelajaran IPA Indonesia*, *5*(2), 1–11.

Hayati, M. N., Supardi, K. I., & Miswadi, S. S. (2013). Pengembangan Pembelajaran IPA SMK Dengan Model Kontekstual Berbasis Proyek Untuk Meningkatkan Hasil Belajar Dan Keterampilan Proses Sains Siswa. *Jurnal Pendidikan IPA Indonesia*, *2*(1), 53–58. https://doi.org/10.15294/jpii.v2i1.2510

Indahwati, D. S., & Abdullah, M. H. (2019). Penerapan Model Pembelajaran Project Based Learning Untuk Meningkatkan Hasil Belajar Siswa Kelas V Sekolah Dasar. *Jurnal Penelitian Pendidikan Guru Sekolah Dasar*, *7*(6), 3542–3556.

Karpudewan, M., Ponniah, J., & Ahmad, A. N. (2016). Project-Based Learning: An Approach to Promote Energy Literacy Among Secondary School Students. *Asia-Pacific Education Researcher*, *25*(2), 229–237. https://doi.org/10.1007/s40299-015-0256-z

Kemdikbud. (2017). *Panduan Implementasi Kecakapan Abad 21 Kurikulum 2013 di Sekolah Menengah Atas*. Kemendikbud.

Kovácsné Pusztai, K. (2021). Evaluation of Project-Based Learning. *Acta Didactica Napocensia*, *14*(1), 64–75. https://doi.org/10.24193/adn.14.1.5

Li, T., Miller, E., Chen, I. C., Bartz, K., Codere, S., & Krajcik, J. (2021). The relationship between teacher's support of literacy development and elementary students' modelling proficiency in project-based learning science classrooms. *Education 3-13*, *49*(3), 302–316. https://doi.org/10.1080/03004279.2020.1854959

Liu, X. (2009). Beyond Science Literacy: Science and the Public. *International Journal of Environmental and Science Education*, *4*(301–311). http://www.ijese.net/makale/1395.html

Lutfi, L., Azis, A. A., & Ismail, I. (2018). Pengaruh Project Based Learning Terintegrasi Stem Terhadap Literasi Sains, Kreativitas dan Hasil Belajar Peserta Didik. *Seminar Nasional Biologi*, *0*, 189–194.

Monika, Y., Mayub, A., & Purwanto, A. (2018). Pengaruh Project Based Learning (PJBL) Model Terhadap Penguasaan Konsep Fisika Pada Siswa Kelas X SMA Negeri 1 Kota Bengkulu. *Jurnal Kumparan Fisika*, *1*(2), 25–30. https://doi.org/10.33369/jkf.1.2.25-30

Muhali, M., Prahani, B. K., Mubarok, H., Kurnia, N., & Asy'ari, M. (2021). The Impact of Guided-Discovery-Learning Model on Students' Conceptual Understanding and Critical Thinking Skills. *Jurnal Penelitian Dan Pengkajian Ilmu Pendidikan: E-Saintika*, *5*(3), 227–240. https://doi.org/10.36312/esaintika.v5i3.581

Muzana, S. R., Jumadi, J., Wilujeng, I., Yanto, B. E., & Mustamin, A. A. (2021). E-STEM project-based learning in teaching science to increase ICT literacy and problem solving. *International Journal of Evaluation and Research in Education (IJERE)*, *10*(4), 1386. https://doi.org/10.11591/ijere.v10i4.21942

Naswir, M., Haryanto, H., & Wati, F. (2017). Analisis Keterlaksanaan Model Pembelajaran Inkuiri Terbimbing Untuk Materi Sifat Koligatif Larutan Dan Pengaruhnya Terhadap Kemampuan Berpikir Kreatif Siswa Kelas Xii Ipa Sma Islam Al-Falah Kota Jambi. *Journal of The Indonesian Society of Integrated Chemistry*, *9*(2), 43–51. https://doi.org/10.22437/jisic.v9i2.5113

Nuri, N., Abidin, Z., & Agreseprianto, R. (2021). *Pembelajaran Fisika Berbasis Proyek Sebagai Upaya Peningkatan Kognitif Dan Sikap Ilmiah Siswa SMK* (No. 2). *2*(2), 1–15.

OECD (Ed.). (2014). *What students know and can do: Student performance in mathematics, reading and science* (Rev. ed., Febr. 2014). OECD.

OECD. (2015). *Results in Focus PISA 2015*. OECD. https://www.oecd.org/pisa/pisa-2015-results-in-focus.pdf

OECD (Ed.). (2019). *What students know and can do*. OECD Publishing. https://doi.org/10.1787/5f07c754-en

Pelger, S., & Nilsson, P. (2016). Popular Science Writing to Support Students' Learning of Science and Scientific Literacy. *Research in Science Education*, *46*(3), 439–456. https://doi.org/10.1007/s11165-015-9465-y

Raehanah, R., Khatimah, H., & Suhirman, S. (2020). Pengaruh Model Pembelajaran Project Based Learning Terhadap Kreatifitas Berpikir Dan Literasi Sains Siswa SMAN 1 Gerung Tahun 2018/2019. *SPIN JURNAL KIMIA & PENDIDIKAN KIMIA*, *2*(1), 13–26. https://doi.org/10.20414/spin.v2i1.2000

Ratih, N. A. (2017). *Hubungan Tingkat Keterlaksanaan Pembelajaran Aktif pada Materi Akuntansi dengan Motivasi Belajar dan Kecerdasan Emosional Siswa*. Universitas Sanata Dharma.

Rohman, S., Rusilowati, A., & Sulhadi, S. (2017). Analisis Pembelajaran Fisika Kelas X SMA Negeri di Kota Cirebon Berdasarkan Literasi Sains. *Physics Communication*, *1*(2), 12–18. https://doi.org/10.15294/physcomm.v1i2.10402

Sari, D. N. A., Rusilowati, A., & Nuswowati, M. (2017). Pengaruh Pembelajaran Berbasis Proyek terhadap Kemampuan Literasi Sains Siswa. *PSEJ (Pancasakti Science Education Journal)*, *2*(2), 114–124.

Srigati, E. (2020). Model pembelajaran berbasis proyek (pjbl) terintegrasi stem untuk meningkatkan literasi sains siswa mts pada materi sistem organisasi kehidupan. *Wawasan: Jurnal Kediklatan Balai Diklat Keagamaan Jakarta*, *1*(1), 141–152. https://doi.org/10.53800/wawasan.v1i1.56

Widiana, R., Maharani, A. D., & Rowdoh, R. (2020). Pengaruh model problem based learning terhadap kemampuan literasi sains siswa sma. *Ta'dib*, *23*(1), 87–94. https://doi.org/10.31958/jt.v23i1.1689

Wong, S. S. H., Kim, M., & Jin, Q. (2021). Critical Literacy Practices Within Problem-Based Learning Projects in Science. *Interchange*, *52*(4), 463–477. https://doi.org/10.1007/s10780-021-09426-4