IMPLEMENTATION OF THE STEAM-BASED PROJECT BASED LEARNING MODEL IN IMPROVING ELEMENTARY SCHOOL STUDENTS' SCIENCE PROBLEM SOLVING ABILITY

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ABSTRACT

This research is motivated by the ability to solve science problems that have not been mastered by students. So that researchers are interested in examining what causes these weaknesses while formulating solutions by applying the STEAM integrated project based learning learning model. The purpose of this study was to examine the effectiveness of using the STEAM-integrated project-based learning model in improving problem-solving abilities in elementary school students' natural sciences learning. The research method used was a quasi-experimental method, which was carried out at MIS Matlaul Anwar class V. The results obtained showed that the t-test result was 6.990 greater than the t-table of 2.457 with a significance level of 0.00 <0.005, which means that there is the influence of the STEAM integrated project based learning learning model on the ability to solve science learning problems in MIS Matlaul Anwar students on the topic of discussion of the human circulatory system. Students who were taught using the project based learning method were better than students who did not use problem based learning in science learning problem solving abilities.

Keywords: *Project Based Learning, STEAM, Science problem solving skills, Elementary Students.*

INTRUDUCTION

Current developments in science and technology have an impact on 21st century learning which requires students to meet the global market for a product based on science and technology. Fridanianti, Purwati & Murtianto (2018: 12) argues that there are four abilities that every student must have, namely: critical thinking and problem solving (critical thinking and problem solving), creativity (creativity), communication skills (communication skills), and the ability to work together (ability to work collaboratively).

The American Association for the Advancement of Science'es also states that the potential for improving life by utilizing science and technology cannot be realized unless society in general understands science, mathematics and technology (Rohman, et al, 2017: 13). It is hoped that by improving the 2006 curriculum into the 2013 curriculum, the current generation of students will be able to face learning problems. The ability to solve problems (problem solving) is an ability that must be possessed by every student and must be developed as early as possible. Because problem solving abilities are related to students' cognitive development. In line with the opinion above Arilaksmi, et al (2021: 2) also argues that the ability that students should master is problem-solving ability, because problem-solving ability affects student learning outcomes.

Furthermore Syaodih (2018: 31) argues that problem solving learning emphasizes the effective use of scientific processes by children to carry out an investigation of a particular object or event that occurs in the surrounding environment. The reality that occurs in the field, there are still many students who experience difficulties in determining these abilities, one of which is the

ability to solve problems related to learning science. The low problem-solving ability of students is evidenced by the low scores obtained by Indonesian students. In the 2015 TIMSS (Trends International Mathematics and Science Study) study results were ranked 44 out of 49 countries with an average score of 397 (Sintawati, Berliana, & Supriyanto, 2020: 27). Then from the results of a survey conducted by PISA (Program for International Student Assessment) under the OECD (Cooperation and Development) which was conducted in 65 countries in the world in 2018, the ability of students in Indonesia was ranked below (Meika, et al, 2021: 384). This shows that the ability of students in Indonesia is still relatively low, especially the ability to solve problems in the field of science.

According to Agusta (2020: 58), the factor that causes the low value of problem solving ability is due to the lack of independence of students in doing exercises or assignments. Because the science learning process in schools rarely invites students to explore the abilities they have during learning activities. Meanwhile, according to Trianto, there are still many students who only memorize concepts and are unable to use these concepts if they find problems in their lives related to the concepts they have, even students are less able to determine problems and formulate them (Sumiantari, et al, 2019: 13).

Therefore there is a great need for a learning model from various learning models that can foster and train science problem solving skills with STEAM-integrated project-based learning, because it can encourage students to be active in solving given problems, starting from important questions, developing plans projects, preparing schedules, monitoring student and project progress, testing and assessing results, evaluating experiences. Cahyadi (2019: 207) states that the project-based learning model is a learning model that uses problems as the first step in gathering and integrating new knowledge based on experience in real activities. With the PjBL learning model students can determine their own collaborative learning process that produces a product. In line with the results of research by Safithri & Huda (2021: 341) that the problem solving abilities of students taught in the PjBL model show superiority to the problem solving abilities of students taught by conventional learning. In completing project-based learning requires a suitable learning approach in order to achieve learning objectives, namely the STEAM approach. STEAM is an integrated learning from five fields of science, namely science, technology, engineering, art and mathematics which is a comprehensive approach as a pattern of problem solving through learning experiences. Annisa (2018: 43) argues that the STEAM learning approach is integrated into the project model by five learning steps, namely planning, developing, working together, and transferring. By applying the PjBL-STEAM learning model in the learning process it is important to improve students' ability to solve problems and foster positive relationships with teachers and peers and become a solution to train students to think in dealing with various problems to gain new knowledge to solve given problems. Based on this explanation, the researcher was interested in conducting research entitled "The Influence of STEAM-Based Project Based Learning Models on Students' Natural Science Problem Solving Ability in Elementary Schools".

METHODOLOGY

This study uses a type of quantitative research with a quasi-experimental method. According to Sugiyono (2016: 114) a quasi-experimental research design is a design that has a control group, but cannot fully function to control external variables that affect the implementation of experimental research. Therefore, the researcher did not form a new class, but the class used was a class that was already in the research school.

The research experimental design used is a quasi experimental design or Quasi Experimental Design using the Nonequivalent Pretest-Posttest Control Group Design experimental design. In this design, two groups were selected as samples, namely the control group and the experimental group which were given different treatments. The design that will be carried out can be seen in the table below.

Table 1. Research Design

Kelas	Pretest	Treatment	Posttest
Eksperimen	O1	X	O2
Kontrol	O3		O4

O1 : Pretest conducted in the experimental class
O3 : Pretest conducted in the control class
X: Treatment using the STEAM-based project based learning model
O2 : Posttest conducted on the experiment
O4 : Posttest conducted in the control class

LITERATURE

Definition of Project Based Learning (PjBL) Learning Model

A process of collaboration between students will be well established if during learning activities using the right learning model. One learning model that is considered appropriate in increasing student collaboration is the project learning model or project based learning.

The project based learning model is a model that involves students to solve problems in making a project. basically it is problem based learning too, it's just that in project based learning the problems used consist of multiple subproblems and activity time (Sulisworo, 2019: 45). Rahman, Suharto and Iriani (2019: 11) also explained that the project based learning model is a learning model that can require students to produce a real product, this is very closely related to aspects of creative thinking knowledge. Fathurrohman (2015: 118) also argues that project-based learning is a learning model that involves a project in the learning process. The implementation of project learning is carried out collaboratively, innovatively, uniquely and focuses on solving problems related to student life. Therefore, project learning can be used by students to participate and be involved in their learning experiences so that students can develop thinking skills from communication and connections to solve a problem. With project-based learning students with the help of teachers not only collect information, but they also have to use their thinking and reasoning abilities to understand information so as to form their own concepts, show the results of problem solving, find an answer to a question or create a new design or look for other solutions from the plans made (Arisanti, et al, 2016: 84).

Based on some of the understandings of the experts above, it can be concluded that the project based learning model is student-centered learning that starts from a background problem and then continues with investigations so that students have new experiences from activities carried out in real time in learning that produces a project. With the final result in the form of a product which includes written or oral reports and presentations.

The characteristics of project-based learning according to the Boston Center for Youth Development and Education in Rati, et al, (2017: 63) are as follows:

1. Students make their own decisions within a pre-determined framework.

2. Students try to solve a problem or challenge that does not have one definite answer.
3. Students are encouraged to think critically, solve problems, collaborate, and try various forms of communication.
4. Students are responsible for finding and managing the information they collect themselves.
5. Evaluation is carried out continuously throughout the project.
6. Students regularly reflect and reflect on what they have done, both the process and the results.

Based on some of the expert explanations above, it can be concluded that the project based learning (PjBL) model has characteristics, namely the teacher as a conveyer of material or someone who poses problems that must be solved by students, then students must plan and design a framework to complete solutions to the problems given, as well as in the process students must cooperate with each other in finding information and evaluating their work so that problems can be resolved, so that students can produce products.

Definition of STEAM

Wulandari (2020: 147) suggests that the STEAM approach is an interdisciplinary approach to studying various STEAM concepts juxtaposed with the real world by applying the principles of science, technology, engineering, art and mathematics. So the STEAM approach is an integrated approach from five fields of knowledge, namely: science, technology, engineering, art and mathematics. Wahyuningsih, et al. (2020: 2) states that STEAM learning is considered capable of integrating the skills (hard skills and soft skills) needed by children in the learning process.

In addition, Usman, et al, (2020: 97) explained that in this STEAM method there are several basic skills that need to be applied by teachers in the learning process. Among them are encouraging children to ask questions, cooperate (involved in children's activities), solve problems (problem solving), explore something and take calculated risks for the impact on children, test solutions to problems, and find new ways of doing things. Because through STEAM children are invited to think comprehensively by linking five aspects in STEAM with the intention of solving problems according to students' abilities.

From the explanation of the experts above, it can be concluded that the STEAM-based learning approach is a suitable approach to improve 21st century skills, with STEAM children will be more active and creative in solving or finding solutions to problems given by combining five aspects of STEAM learning.

Learning activities suitable for the STEAM approach are project based learning activities. The integration of STEAM with the PjBL model has been successfully used to develop student abilities such as working together, communicating, critical thinking, caring for the environment, hard work, adaptability skills, responsibility, creative thinking, leadership, curiosity and honesty (Apriliana, et al, 2018 :43). The STEAM approach in collaboration with project-based learning can target one or more pieces of content. The application of STEAM with the PjBL model can develop student skills, one of which is problem solving ability.

The learning stages of the STEAM-based PjBL model in this study according to Diana Laboy-Rush in Afriana, et al (2016: 262-263), namely:

1. Reflection
   The first stage aims to bring students into the context of the problem and inspire students to immediately start an investigation.
2. Research
   The second stage is the form of student research. At this stage the teacher provides science learning, selects readings, or other methods to collect relevant information sources. During this

stage the teacher guides the discussion to determine whether students have developed a conceptual and relevant understanding based on the project.

3. Discovery
   The discovery stage generally involves the research process and information that is known in the preparation of the project.
4. Application
   The application stage aims to test the product in solving problems.
5. Communication
   The final stage in each project is to make a product by communicating between friends and within the class. Presentation is an important step in the learning process to develop communication and collaboration skills.

IPA Problem Solving Ability Problem solving ability is an important component in learning science. Because science learning in elementary schools is taught how to instill a sense of curiosity about the natural surroundings, the success of this learning is closely related to students' problem-solving abilities. Because problem solving skills are seen as an important part of learning science and also everyday life. According to Rahayu, Siburian, & Suryana (2021: 16) the ability to solve natural science problems is the process of eliminating differences or discrepancies that occur between the results obtained and the desired results.

Sumarmo in Amam (2017: 41) states that problem solving can be seen from two different perspectives, namely as a learning goal and as a learning approach. Then Husna and Burais (2018: 4) also state that problem-solving ability is a series of learning activities that emphasize students' problem-solving processes faced scientifically to improve students' mastery of the material, train students' problem-solving skills and show the relationship between theory and reality to student. Problem-solving activities in science learning encourage creative thinking by directing students to develop new knowledge.

Based on the explanation of the experts above, it can be concluded that problem solving ability is fundamental in science learning, so problem solving ability is the process of combining existing knowledge with new knowledge to solve these problems, but it cannot be denied that each student has a different way. -different in solving problems this is due to the ability to solve problems has special abilities or skills that students have. Indicators of problem solving ability according to G. Polya in Ramadhan, et al (2021: 324 namely 1) Understanding the problem, 2). Planning problem solving, 3) Solving problems according to plan, 4) Re-checking the results obtained.

RESULTS AND DISCUSSION

Experimental Group

The science problem-solving ability test was given to VC class of 26 students, with a total of 6 questions. The administration of a science problem solving ability test was given before the treatment was given to determine the students' initial abilities. Based on the results of data analysis, it was obtained that the value of science learning outcomes in the experimental class pretest obtained with an average value of 65.62; maximum value of 84.37; minimum value of 18.75; range 65; standard deviation 16.08; variance 258.59; and respondent 26.

Posttest

While the posttest results; after being given a pretest, then students in the experimental group will be given treatment, namely with the STEAM integrated Project Based Learning learning model which takes place in 6 meetings. After being given treatment, students will then be given a

posttest to find out whether there is an influence in the application of the learning model. Science problem solving ability test using 6 questions. The value of science learning outcomes in the posttest experimental class obtained an average score of 79; maximum value 94 minimum value 56; range 38; standard deviation 9.88; variance 97.79; and respondent 26.

Control Group

The results of the control class pretest science problem solving ability test results through a written test in the form of essay questions totaling 7 questions given to 23 students. With the aim to determine the ability to solve problems early in the control class. Source: Data processing Ms. Excel 2019. Based on the data above, it can be seen that the description of the value of the experimental class' pretest science learning outcomes obtained with an average value of 47.88; maximum value of 70; minimum value of 18.75; range 51; standard deviation 15.72; variance 247.72; and respondent 23.

In posttest evaluation students will be given 6 learning meetings after being given pretest questions by applying conventional learning models because they are not given treatment. Furthermore, students will be given a posttest to find out the final result of the learning process that has been carried out. The results of calculations from data analysis on the posttest data from mathematics learning outcomes in the control class posttest obtained an average value of 52.73; maximum value 70; minimum value 28; range 42; standard deviation 13.73; variance 188.73; and respondent 23.

Based on the results of the data presented above, the researcher describes the data as a whole from the pretest and posttest results in the experimental class and control class using the histogram image below:

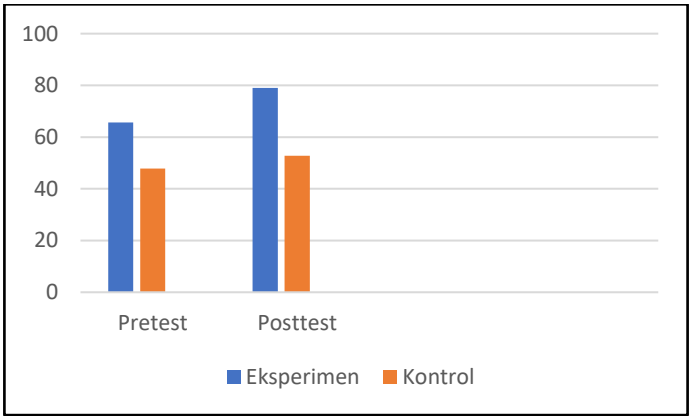

Figure 1. Histogram of Pretest and Posttest Scores of Science Problem Solving Ability in Experiment Class and Control Class

Hypothesis testing

After carrying out the normality test and homogeneity test and obtaining data that is normally distributed and data that is homogeneously distributed, it is possible to compare the average using the independent sample t-test using SPSS software with the assumption that both data are homogeneous with a significance level of 0.05, a tcount of 0.05 is obtained. 6.990 which means greater than the ttable value of 2.457 with a significance level of 0.000 <0.005. Based on this, it can be seen that there are differences between the students in the experimental class and the control class. So it is found that there is an influence of the Project Based Learning learning model on the written mathematical communication skills of class V MI Mathlaul Anwar.

Discussion

Data from observations of student and teacher activities were obtained from observer assessments carried out at each meeting, that is, for 6 meetings. There are student and teacher observation assessment sheets given to the experimental class and control class. The data from the observations of the two classes are displayed in tables and histograms as follows:

Table 2. Average Observation Results of Student Activity Experiment Class and Control Class

Kelas	Hasil rata-rata Pertemuan						Rata-rata
	1	2	3	4	5	6	
Eksperimen	3,0	3,3	3,6	3.8	4,0	4,3	3,66
Kontrol	2,7	2,9	3,1	3,4	3,6	3,9	3,26

The average histogram of the results of observations of student activity in the experimental class and control class is shown in the figure below:

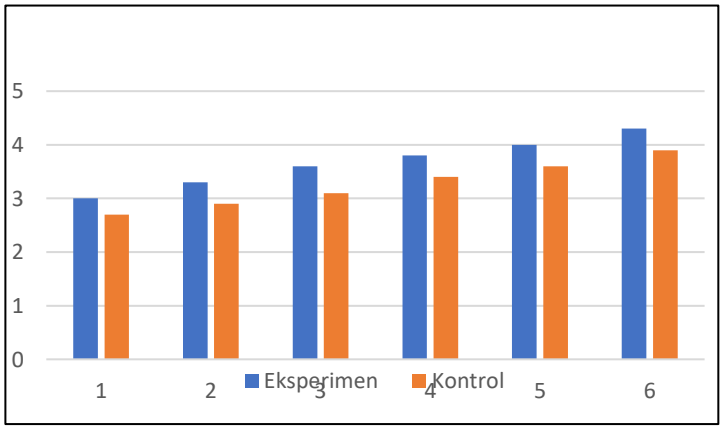

Figure 2. Histogram of Average Observation Results of Student Activities in the Experiment Class and Control Class.

If seen from table 4.6 and figure 4.2, the average result of observing student activity in the experimental class is 3.66, while the average result of observing student activity in the control class is 3.26. Based on these data there is a difference of 0.4 between the experimental class and the control class. Therefore, it can be concluded that the average results of observations of the activities of experimental class students are higher than the average results of observations of control class activities.

In the early stages the researcher looked at the value of science learning outcomes for class VA and VC students. This is done to determine which class will be used as the experimental class and the control class. After that, the researcher gave a pretest for both the experimental class and the control class to determine students' basic abilities before treatment. Based on the results of the pretest data, it is known that the VA class got an average score of 47.88 and the VC class got an average score of 65.62. The results of these data can be concluded that the average value between the two classes is still low. There are several reasons for the low yield data, namely because students still have difficulty working on the pretest questions given, students still have not trained their thinking skills due to limited processing time so that students become less active and

understand the material in the questions given. The following is evidence of giving pretest questions for the experimental class and the control class.

After giving the pretest questions and the average score of the two classes, then by giving treatment, namely providing learning using the project based learning model in the VC class. Meanwhile, the VA class or control class uses a learning process using conventional models. Initial activities in the learning process in VC class or experimental class, the results showed that students found it difficult to understand the human circulatory system material, besides that they still felt afraid to express opinions and ask the teacher about the material being studied, as well as students still feel difficult to solve problems in a given question. After that, the VC class or experimental class was then given treatment using and applying the project based learning learning model in the learning process activities, while the control class, namely the VC class, was given treatment using a conventional learning model. In addition, questions were asked to both classes after the test to determine the final ability in both classes. Based on the posttest data, the VC class or experimental class has an average value of 79 while the VA class or control class has an average value of 52.79.

Statistically, the data, facts, and results collected based on the research and analysis conducted show that there are differences in students' natural science abilities between classes that are given treatment and classes that are not given treatment. This can be proven by using the t-test of independent samples, which shows that tcount is 6.990 greater than ttable with a significance level of 0.000 > 0.005. This shows that there are disparities in solving written problems. There is a significant difference between students in the experimental group and the control group. It can also be said that the project based learning learning model has an effect on the ability to solve science problems in class V MI Mathlaul Anwar.

The stages in applying the STEAM integrated project based learning learning model in the experimental class are as follows:

1. The teacher greets and invites students to pray, after that the teacher takes student attendance and asks how students are doing today's lesson, then the teacher mentions the learning objectives and arouses students' learning motivation to be more active in learning by asking a number of questions which raises student curiosity.
2. The teacher organizes by making study groups consisting of 4-6 students. Then the teacher gives assignments that must be completed to each study group.
3. The teacher guides students in collecting data that is suitable for analysis and obtaining explanations in solving problems on the questions then students are asked to make a project with material on the human circulatory system.
4. The teacher asks each group representative to present their work orally.
5. The teacher provides discussion of questions and input if there are errors or mistakes in students. In addition, students are also given the opportunity to give opinions to other groups.

CONCLUSION

Based on the results of the research and discussion that have been described and the data presented, the following conclusions can be drawn:

1. The ability to solve written science problems in fifth grade students with MI Mathlaul Anwar's human circulatory system material between the class/experimental group and class/control group has a different significance, this is based on the results of researchers' calculations using a t-test using SPSS type 25 software with a tcount of 6.990 which is greater than the result of a ttable of 2.457 with a significance level of 0.000 <0.005.

2. Based on the results of the analysis of data collection that the ability to solve science problems is written in the circulatory system material that the class/experimental group gets a higher average score than the class/control group. Based on the results of the pretest score, it was found that the experimental class/group, namely the VC class, received an average score of 65.62 and the control class/group received an average score of 47.88 while for the posttest in the experimental class/group, namely the VC class, the average score is 79 and in the control group/class get an average score of 52.73. Using a problem-based learning model can make students involved with the learning process, so that students become active, independent and able to be responsible for their duties. Students are also more confident in expressing their opinions, thinking more optimally and student-centered learning by discussing with group friends to exchange opinions and arguments and thoughts with other group members. So that the ability to solve written science problems increases because it applies a project based learning learning model.

SUGGESTION

1. For the teacher, as an educator in giving lessons it is better to develop a more varied learning model, with the aim that students play a more active role for students and make students more interested and enthusiastic.
2. For students, as students to be more responsible for the obligations of a student even in online learning conditions and it is better to repeat lessons more often or review lessons that have been studied with the aim of being more familiar with the material being taught already studied.
3. For schools, as school principals pay more attention to all aspects in supporting the learning process to take place, both from the application of methods, strategies and learning models to be used, as well as the availability of facilities and infrastructure as supports during learning activities so that learning goes well and efficiently .
4. Researchers hope that further research on mathematical communication skills will be carried out with other subjects. In addition, it is expected to apply other innovative learning models so that the learning process can run more meaningfully and students can be involved in the learning process.

REFERENCES

Afriana, J., Permanasari, A., & Fitriani, A. (2016). Project Based Learning Integrated to STEAM to Enchance Elementary School's Students Scientific Literacy. *Jurnal Pendidikan IPA Indonesia*, 262-263.

Agusta, E. S. (2020). Peningkatan Kemampuan Pemecahan Masalah Matematika melalui Model Pembelajaran Berbasis HOTS . *Jurnal Riset Pembelajaran Matematika Sekolah*, 58.

Akbar, P., Hamid, A., Bernard, M., & Sugandi, A. I. (2018). Analisis Kemampuan Pemecahan Masalah dan Disposisi Matematik Siswa Kelas XI SMA Putra Juang Dalam Materi Peluang. *Jurnal Cendikia: Jurnal Pendidikan Matematika*, 146.

Amam, A. (2017). Penilaian Kemampuan Pemecahan Masalah Matematis Siswa SMP . *Jurnal Teori dan Riset matematika(TEOREMA)*, 42.

Annisa, d. (2018). Peningkatan Kemampuan Berpikir Kreatif Siswa dengan Menggunakan Model Project Based Learning Berbasis STEAM (Science, Technology, Engineering, Arts Dan Mathematic) Pada Materi Asam dan Basa di SMAN 11 Kota Jambi. *Journal of the Indonesian Society of Integrated Chemistry*, 43.

Apriliana, R. M., Ridwan, A., Hadinugrahaningsih, T., & Rahmawati, Y. (2018). Pengembangan Soft Skills Peserta Didik melalui Integrasi Pendekatan Science, Technology, Engineering, Arts, and Mathematics (STEAM) dalam Pembelajaran Asalm Basa. *Jurnal Riset Kimia*, 43.

Arilaksmi, N. G., Susiswo, & Sulandra, I. M. (2021). Kemampuan Pemecahan Masalah Open-Ended Siswa SMP Berdasarkan Tahapan Polya. *Jurnal Pendidikan Matematika dan Matematika*, 2.

Arisanti, W. O., Sopandi, W., & Widodo, A. (2016). Analisis Penguasaan Konsep dan Keterampilan Berpikir Kreatif Siswa SD Melalui Project Based Learning. *EduHumaniora*, 84.

Azwar, S. (2019). *Reliabilitas dan Validitas Edisi 4.* Yogyakarta: Pustaka Pelajar.

Cahyadi, E. (2019). Peningkatan Hasil Belajar Tematik Terpadu Melalui Model Project Based Learning Pada Siswa Sekolah Dasar. *Jurnal Riset Teknologi dan Inovasi Pendidikan*, 207.

Dermawan, D., & Wahyudin, D. (2018). *Model Pembelajaran di Sekolah.* Bandung: PT Remaja Rosdakarya.

Fathurrohman , M. (2015). *Model-model Pembelajaran Inovatif Alternatif Desain Pembelajaran yang Menyenangkan.* Jogjakarta: Ar-Ruzz Media.

Fridanianti, A., Purwanti, H., & Martianto, Y. H. (2018). Analisis Kemampuan Berpikir Kritis Dalam Menyelesaikan Soal Aljabar Kelas VII SMP Negeri 2 Pangkah Ditinjau dari Gaya Kognitif Reflektif dan Kognitif Impulsif . *Aksioma*, 12.

Fridanianti, A., Purwati, H., & Murtianto, H. Y. (2018). Analisis Kemampuan Berfikir Kritis Dalam Menyelesaikan Soal Aljabar Kelas VII SMP Negeri 2 Pangkah Ditinjau dari Gaya Kognitif Reflektif dan Kognitif Impulsif. *Aksioma*.

Gultom, M. (2018). Pengaruh Pendekatan Pembelajaran Problem Based Learning Terhadap Kemampuan Berpikir Kritis di MTS Negeri Rantauprapat. *Jurnal Pembelajaran dan Biologi*, 2.

Hamzah, A., & Muhlisrarini. (2016). *Perencanaan Pembelajaran danStrategi Pembelajaran Matematika.* Jakarta: Rajawali Pres.

Hasnunidah, N. (2017). *Metodologi Penelitian Pendidikan.* Yogyakarta: Media Akademi.

Hidayat , W., & Sariningsih, R. (2018). Kemampuan Pemecahan Masalah Matematis dan Adversity Quotient Siswa SMP Melalui Pembelajaran Open Ended. *Jurnal JNPM (Jurnal Nasional Pendidikan Matematika)*, 111.

Husna, & Burais, F. F. (2018). Penggunaan Problem Solving untuk Meningkatkan Kemampuan Pemecahan Masalah Matematis Siswa SMP. *Jurnal Peluang*, 4.

Kadir. (2015). *Statistika Terapan.* Jakarta: PT Rajagrafindo Persada.

Khanifatul. (2014). *Pembelajaran Inovatif.* Jogjakarta: Ar-Ruzz Media.

Lestari, K. E., & Yudhanegara, M. R. (2015). *Model-Model Pembelajaran Inovatif.* Bandung: PT Refika Aditama.

Maolani, R. A., & Cahyana, U. (2015). *Metodologi Penelitian Pendidikan* (Pertama ed.). Bandung: PT Remaja Rosdakarya.

Meika, I., Ramadina, I., Sujana, A., & Mauladaniyat, R. (2021). Kemampuan Pemecahan Masalah Matematis Siswa Dengan Menggunakan Model Pembelajaran SSCS . *Jurnal Pendidikan Matematika* , 384.

Muliana, A. R. (2018). Model-Model Pembelajaran Inovatif. *Journal of Pedagogy* , 55.

Neolaka, A. (2014). *Metode Penelitian dan Statistik .* Bandung: Rosdakarya.

Noviyana, H. (2017). Pengaruh Model Project Based Learning Terhadap Kemampuan Berpikir Kreatif Matematika Siswa. *Jurnal Edumath*, 112.

Nurfitriyanti, M. (2016). Model Pembelajaran Project Based Learning Terhadap Kemampuan Pemecahan Masalah Matematika. *Jurnal Formatif*, 153.

Rahayu, O., Siburian, M. F., & Suryana, A. (2021). Analisis Kemampuan Pemecahan Masalah IPA Siswa Kelas VII pada Konsep Pencemaran Lingkungan di MTs. Asnawiyah Kab. Bogor . *Biological Science and Education Journal*, 16.

Rahman, M. K., Suharto, B., & Iriani, R. (2019). Meningkatkan Berpikir Kreatif dan Hasil Belajar Menggunakan Model PjBL Berbasis STEAM Pada Materi Larutan Elektrolit dan Nonelektrolit. *Journal Chemistry And Education*, 11.

Ramadhan, A., Anwar, S., & Falak, A. F. (2021). Analisis Keselahan Siswa Dalam Menyelesaikan Soal Pemecahan Masalah Matematik Siswa SMK Kelas X Materi Sistem Persamaan Linear Dua Variabel. *Jurnal Pembelajaran Matematika Inovatif*, 324.

Rati, N. W., Kusmaryanti, N., & Radiani, N. (2017). Model Pembelajaran Berbasis Proyek, Kreativitas dan Hasil Belajar Mahasiswa. *Jurnal Pendidikan Indonesia*, 63.

Riduwan. (2015). *Belajar Mudah Penelitian Untuk Guru-Karyawan dan Penelitian Pemula.* Bandung: Alfabeta.

Riyana, M., Farida, & Dewi, N. R. (2021). Analisis Kemampuan Pemecahan Masalah: Dampak Pembelajaran Inside Outside Circle (IOC) dengan Pendekatan Metaphorical Thinking dan Self Regulated Learning. *MAJU*, 27.

Rohman, S., Rusilowati, A., & Sulhadi. (2017). Analisis Pembelajaran Fisika Kelas X SMA Negeri di Kota Cirebon Berdasarkan Literasi Sains. *Physics Communication*, 13.

Rohman, S., Rusilowati, A., & Sulhadi. (2017). Analisis Pembelajaran Fisika Kelas X SMA Negeri di Kota Cirebon Berdasarkan Literasi Sains. *Physics Communication*, 13.

Safithri, R., & Huda, N. (2021). Pengaruh Penerapan Problem Based Learning (PBL) dan Project Based Learining (PJBL) Terhadap Kemampuan Pemecahan Maslah Berdasarkan Self Efficacy Siswa. *Jurnal Pendidikan Matematika*, 341.

Setyosari, H. P. (2013). *Metode Penelitian Pendidikan & Pengembangan.* Jakarta: Prenamedia Group.

Sintawati, M., Berliana, L., & Supriyanto, S. (2020). Real Mathematics Education (RME) untuk Meningkatkan Hasil Belajar dan Kemampuan Pemecahan Masalah Matematika Siswa Sekolah Dasar. *Jurnal Penelitian Tindakan Kelas dan Pengembangan Pembelajaran*, 27.

Sugiyono. (2016). *Metode Penelitian Pendidikan Pendekatan Kuantitatif, Kualitatif, dan R&D.* Bandung: Alfabeta.

Sugiyono. (2017). *Statistika untuk Penelitian.* Bandung: Alfabeta.

Suharsaputra, U. (2014). *Metode Penelitian Kuantitatif, Kualitatif dan Tindakan.* Bandung: PT Refika Aditama.

Sulisworo, D. (2019). *Konsep Pembelajaran Project Based Learning* . Semarang: Alprin.

Sumiantari, N. E., Suardana, I. N., & Selamet, K. (2019). Pengaruh model Problem Based Learning Terhadap Kemampuan Pemecahan Masalah IPA Siswa Kelas VIII SMP. *Jurnal Pendidikan dan Pembelajaran Sains Indonesia*, 13.

Sundayana, R. (2016). *Statistika Penelitian Pendidikan.* Bandung: Alfabeta.

Surya, A. P., Relmasira, S., & Hardini, A. T. (2018). Penerapan Model Pembelajaran Project Based Learning (PjBL) Untuk Meningkatkan Hasil Belajar dan Kreatifitas Siswa Kelas III SD Negeri Sidorejo Lor 01 Salatiga. *Jurnal Pesona Dasar*, 45.

Susanto, A. (2014). *Teoti Belajar dan Pembelajaran di Sekolah Dasar.* Jakarta: Prenadamedia group.

Syaodih, E. (2018). Pengembangan Kemampuan Pemecahan Masalah Anak Usia Dini Dalam Pembelajaran Proyek di Taman Kanak-kanak. *Jurnal Pendidikan Usia Dini*, 31. doi:https://doi.org/10.21009/JPUD.121

Tinanti, Y. R. (2018). *Model Pembelajaran Berbasis Proyek (PBP) dan Penerapannya dalam Proses Pembelajaran di Kelas.* Yogyakarta: CV Budi Utama.

Usman, J., Nisa, L., Prasetyo, D., & Virdyna, N. K. (2020). Penguatan Satuan PAUD melalui Pendekatan Pembelajaran Berbasis STEAM dalam Pendidikan Abad 21 di Taman Kanak-kanak Islam Terpadu Nurul Hidayah Sampang. *Journal of Community Engagement* , 97.

Wahyuni, E., & Fitriana. (2021). Implementasi Model Pembelajaran Project Based Learning (PjBL) Dalam Meningkatkan Hasil Belajar Peserta Didik Pada Mata Pelajaran Pendidikan Agama Islam SMP Negeri 7 Kota Tangerang. *Jurnal Pendidikan Islam dan Pendidikan Tadarus Tarbawy*, 325.

Wahyuningsih, S., Pudyaningtyas, A. R., Nurjanah, N. E., Dewi, N. K., Hafidah, R., Syamsuddin, M. m., & Soleha, V. (2020). The Utilization of Loose Parts Media in STEAM Learning for Early Childhood. *Early Childhood Education and Development Journal*, 2.

Wajdi, F. (2017). Implementasi Project Based Learning (PBL) dan Penilaian Autentik dalam Pembelajaran Drama Indonesia . *Jurnal Pendidikan Bahasa dan Sastra*, 86.

Warsono, & Hariyanto. (2012). *Pembelajaran Aktif.* Bandung: PT Remaja Rosdakarya.

Winarni, E. S., & Harmini, S. (2014). *Matematika Untuk PGSD.* Bandung: PT Remaja Rosdakarya.

Wulandari, L. (2020). Penerapan Pendekatan STEAM Berbasis Projek "Pendopo Joglo" untuk Meningkatkan Keterampilan 4c Kelas VIII. *Jurnal Profesi Keguruan*, 147.