Thinking Skills and Creativity Journal
Volume 6, Number 1, Tahun 2023, pp. 19-26
P-ISSN: 2615-4692 E-ISSN: 2615-6105
Open Access: https://doi.org/10.23887/tscj.v6i1.61654

HOTS Oriented Problem-Based Learning Model: Improving Critical Thinking Skills and Learning Outcomes of Fifth Grade Students in Science Learning

I Gede Eric Cantona[1*], I Wayan Suastra[2], I Made Ardana[3]

[1,2]Prodi Pendidikan Dasar, Universitas Pendidikan Ganesha, Singaraja Indonesia

ARTICLE INFO

Article history:
Received January 08, 2023
Revised Jaunary 21, 2023
Accepted March 25, 2023
Available online April 25, 2023

Kata Kunci:
PBL, kemampuan berpikir kritis, hasil belajar.

Keywords:
Problem-based model, critical thinking skills, learning outcomes

ABSTRAK

Kurangnya penerapan model pembelajaran yang memberikan masalah-masalah HOTs menyebabkan rendahnya hasil belajar IPA dan kemampuan berpikir kritis siswa. Sehingga perlunya penerapan model yang mampu membuat hasil belajar IPA dan kemampuan berpikir kritis siswa menjadi meningkat, salah satunya adalah menggunakan model pembelajaran berbasis masalah berorientasi HOTs. Penelitian ini bertujuan untuk menganalisis pengaruh model pembelajaran berbasis masalah berorientasi HOTS terhadap kemampuan berpikir kritis dan hasil belajar IPA siswa. Populasi penelitian ini adalah seluruh siswa kelas V SD yang berjumlah 150 siswa. Sampel penelitian ini ditentukan dengan teknik random sampling dengan jumlah 75 siswa. Data yang diperlukan dalam penelitian ini dikumpulkan melalui tes kemampuan berpikir kritis dan tes hasil belajar. Setelah data terkumpul lalu dianalisis dengan MANOVA. Hasil penelitian ini menunjukkan: terdapat pengaruh simultan kemampuan berpikir kritis dan hasil belajar IPA antara kelompok yang dibelajarkan dengan model pembelajaran berbasis masalah berorientasi HOTS (F= 11.125 ≥ p= 0,05); terdapat perbedaan yang signifikan kemampuan berpikir kritis siswa antara kelompok siswa yang dibelajarkan dengan model berbasis masalah berorientasi masalah HOTS (F= 21,901 ≥ p= 0,05); dan terdapat perbedaan yang signifikan hasil belajar IPA antara yang dibelajaran dengan model berbasis masalah berorientasi masalah HOTS (F= 10,827 ≥ p= 0,05). Meningkatnya kemampuan berpikir kritis siswa didasari dengan dilatihnya siswa untuk memecahkan suatu permasalahan. Siswa dituntut untuk berpartisipasi aktif dalam bertanya dan menanggapi pertanyaan sehingga siswa mampu mengembangkan kemampuan berpikir kritisnya.

ABSTRACT

The lack of application of learning models that provide HOTs problems causes low science learning outcomes and students' critical thinking skills. So that it is necessary to apply a model that can improve science learning outcomes and students' critical thinking skills, one of which is using a HOTs-oriented problem-based learning model. This study aims to analyze the effect of the HOTS-oriented problem-based learning model on students' critical thinking skills and science learning outcomes. The population of this study was all 150 students of fifth-grade Elementary School. The research sample was determined by random sampling technique with 75 students. The data needed in this study were collected through tests of critical thinking skills and learning achievement tests. After the data was collected, it was analyzed using MANOVA. The results of this study indicate: that there is a simultaneous effect of critical thinking skills and science learning outcomes between the groups taught by the HOTS-oriented problem-based learning model (F = 11.125 ≥ p = 0.05); there is a significant difference in students' critical thinking skills between groups of students who are taught with the HOTS problem-oriented problem-based model (F = 21.901 ≥ p = 0.05); and there is a significant difference in science learning outcomes between those who are taught with the HOTS problem-oriented problem-based model (F = 10.827 ≥ p = 0.05). Increasing students' critical thinking skills requires training students to solve a problem. Students are required to participate actively in asking and responding to questions so that students can develop their critical thinking skills.

*Corresponding author
E-mail addresses: cona.ost@gmail.com (I Gede Eric Cantona)

1. INTRODUCTION

Natural Science is one of the important subjects to be taught in elementary school. By learning science, students are expected to be able to solve the problems they face in everyday life. In general, natural science is the science of a collection of knowledge about natural phenomena which are systematically arranged (Tyas et al., 2020; Wahyuni et al., 2019). Science is ideally taught by presenting science concepts systematically and contextually; using a scientific approach; using a variety of learning media; activating students in learning; developing critical and creative thinking skills; and emphasizing the provision of hands-on learning experiences (Arya, 2020; Juniati, N. W., & Widiana, 2017; Sudana & Wesnawa, 2017). More specifically, the science learning process should refer to the demands of 21st-century education, learning processes oriented towards developing problem-solving and higher-order thinking skills.

However, learning science in elementary school has yet to run as expected. It can be seen from the low student learning outcomes in science. Survey results from TIMSS (Trend In International Mathematics and Science Study) in 2015 showed Indonesia ranked 44 out of 49 survey participating countries (Ambussaidi & Yang, 2019; Hadi & Novaliyosi, 2019). Meanwhile, in the 2018 PISA (Program for International Student Assessment) survey results, Indonesia was ranked 62 out of 77 countries participating in the survey (Narut & Supradi, 2019; S. N. Pratiwi et al., 2019). The indicators or basis used by PISA and TIMSS in conducting the survey are reasoning and problem-solving skills (higher-order thinking skills) that emphasize various problems and situations in everyday life related to science material. The abilities tested in PISA are grouped into process components, the ability to understand and solve problems (problem-solving), reasoning skills (reasoning), and communication skills (Fathani, 2016; Oktaviana & Rosyidi, 2019). It is by learning in the 21st century which emphasizes higher-order thinking encompassing four things. One is critical thinking (critical thinking and problem-solving) (Fajriyah, K., & Agustini, 2018; Makhrus et al., 2018).

Meanwhile, it is known that learning science in elementary schools is still oriented toward developing lower-level thinking skills. This condition also occurs in SD Saraswati 3 Denpasar. Based on the results of observations found several problems: learning in schools still uses low-level thinking problems, the implementation of innovative learning models is not optimal, judging from students' critical thinking skills is still not optimal, science learning outcomes are still relatively low, assessment of problem-based learning models in their influence on critical thinking skills is still lacking, and assessment of problem-based learning models in their effect on science learning outcomes in elementary schools is still lacking.

Seeing this gap, a problem-oriented learning model must be applied to improve students' critical thinking skills and learning outcomes. The ability to think critically is one of the abilities that a person should have. In the information age, every time people are flooded with information both from print and electronic media, both true or factual information or hoaxes (Imanuel, 2015; A. Pratiwi & Asyarotin, 2019). Critical thinking skills are needed to sort and select correct and useful information for oneself, society, nation, and state. If you can think critically, people will be easily led by accurate opinions or hoax news. The ability to think critically is also important in the era of globalization marked by competition in various fields. The quality of human resources, marked by the ability to think critically, will become an important asset in this competitive context. This higher-order thinking ability includes thinking critically, systematically, and creatively in solving problems (Lavi et al., 2021; Rovers et al., 2018; Sung, 2017). Furthermore, a student-centered science learning process with a problem-solving orientation will increase student learning motivation. Therefore, developing critical thinking skills needs to be the focus of attention in education and learning in schools (Agnafia, 2019; Huang et al., 2020). It will require students to have good critical thinking skills. If students have good critical thinking skills, students can choose and sort the correct information (Nugraha et al., 2017; Nugroho & Airlan, 2020). One way for students to have good critical thinking skills is to use a problem-based learning model. Using a problem-based learning model, students can develop critical thinking skills by solving a problem in small groups.

The problem-based learning model is a learning model that starts with giving problems to students, and then these students look for solutions to solve the given problems. In other words, the problem-based model is a learning process that is carried out based on a problem. Through the application of this model, learning will rely on student learning activities, while the teacher's role is only to guide and direct learning. The application of this model is also by critical thinking indicators, focusing on problems, asking and answering questions, focusing on problems, making and assessing an observation, making conclusions, and deciding on actions (Grahito., 2020; Nitko, 2011). Several studies also explain that using problem-based learning models in the learning process positively influences students' critical thinking skills (Helmon, 2018; Sianturi et al., 2018; Wahyuni, S., & Anugraheni, 2020). Previous research showed increased critical thinking skills through problem-based learning models with

outdoor learning (Nugraha et al., 2017). So, by applying a problem-based learning model, students will be faced with problems in the learning process, which will be able to improve students' critical thinking skills and learning outcomes. It is because students feel challenged to work together to hone problem-solving skills by collecting and analyzing data to solve problems and find solutions. The advantages of using this problem-based learning model are that problem-solving techniques are the right way to digest important points of a topic, foster student skills in building new knowledge from problem-solving, increase student activity in learning, familiarize students with connecting their understanding and experience in digesting and solve problems experienced, train critical thinking skills, and this model can optimize one's interest in learning consistently (Anazifa & Djukri, 2017; Mutakinati et al., 2018). But on the other hand, many teachers need to balance HOTS problems to apply this problem-based learning model. Seeing this, if the problem-based learning model is applied to the problems that occur, LOTS is not by the characteristics of the problem-based learning model, problem-oriented.

Bloom's revised taxonomy differentiates thinking processes into higher-order thinking skills, often called Higher Order Thinking Skills (HOTS), and Lower Order Thinking Skills (LOTS), low-level thinking skills. Cognitive processes are at C4, C5, and C6 for the cognitive domain of HOTS questions (Antara & Dewantara, 2022; Septiyani et al., 2020). Therefore, this problem-based learning model is very suitable to be oriented to HOTS problems to improve students' critical thinking skills and learning outcomes. When this problem-based learning model is oriented to HOTS problems, it will be by the characteristics of the problem-based learning model, problem-oriented, and by the revised Bloom taxonomy, which refers to C4 to C6. The results of previous research also explain that using HOTS-oriented problem-based learning models can improve students' learning outcomes and critical thinking skills (Cik'ani, 2021). In addition, other studies state that in their research, one of the learning models that are relevant and can be applied to improve students' Higher Order Thinking Skills (HOTS) abilities is the problem-based learning model (Afandi, M., & Handayani, 2020; Farhan, M., & Arisona, 2022). Based on the description above, the purpose of this study was to analyze the simultaneous effect of critical thinking skills and science learning outcomes between groups of students who were taught with the hots problem-oriented problem-based learning model and groups of students who were not taught with the hots problem-oriented problem-based learning model of fifth-grade elementary school.

2. METHOD

The type of research that will be carried out in this research is quantitative research with an experimental design, quasi-experiment. The quasi-experimental form used in this study was the post-test-only control group design. This study will test the effect of problem-oriented hots-oriented problem-based learning models on fifth-grade students' critical thinking skills and science learning outcomes. The population in this study were all fifth-grade students at SD Saraswati 3 Denpasar. Sampling research using a random sampling technique. The VA class became the experimental group with 37 students, and the VD class was the control group with 38 students. The data collection technique in this study used an essay test with ten questions, each referring to the revised taxonomy of bloom from C4 to C6. After the data collection technique is carried out later through an essay test, the results of critical thinking skills and learning outcomes are limited to students' natural science cognitive learning outcomes. After the test is made, it will be tested to determine if it is feasible. The tests carried out were the content validity test (Gregory), item validity test (moment product), and test reliability (Cronbach Alpha).

The data analysis method collected was in the form of learning outcomes and students' critical thinking skills through a post-test. The data that has been collected will be analyzed through several stages, such as descriptive analysis to calculate the mean, median, mode, and prerequisite tests, including normality tests and homogeneity tests, correlation tests between dependent variables, and hypothesis testing. The first hypothesis was analyzed with Manova, and the second and third hypotheses were analyzed using one-way anava.

3. RESULT AND DISCUSSION

Result

This study aims to determine the significant effect of hots-oriented problem-based learning models on science learning outcomes and fifth-grade students' critical thinking skills. The sample in this study was 37 VA class students in the experimental class who were taught the HOTS-oriented problem-based learning model and 38 VD class students in the control class who were not taught the HOTS-oriented problem-based learning model. The two sample classes were given treatment in 7 meetings, and

the 8th meeting was given a post-test. After collecting data through the post-test, the first hypothesis test was conducted using MANOVA. The results can be presented in the form of Table 1.

Table 1. Summary Table of the First Hypothesis Test

StatistiC	F Score	Significance Score (sig.)	Conclusion
Pillai's Trace	11.125	0.000	Significant
Wilks' Lambda	11.125	0.000	Significant
Hotelling's Trace	11.125	0.000	Significant
Roy's Largest Root	11.125	0.000	Significant

Based on Table 1, it is known that the sig. for Pillai's Trace, Wilks' Lambda, Hotelling's Trace, and Roy's Largest Root are smaller than 0.05. Thus, H0 is rejected, or there is a simultaneous influence of critical thinking skills and science learning outcomes between the group taught with the HOTS-oriented problem-based learning model and the group of students who were not taught with the HOTS-oriented problem-based learning model for fifth grade SD Saraswati 3 Denpasar 2022/2023. The second and third hypotheses were carried out using one-way ANOVA. The test criteria are if Fcount ≥ Ftable at a significance level of 5%, then H1 is accepted, and H0 is rejected. Apart from using the Anava A formula, the second and third hypotheses can be tested using SPSS 17.0 for the Windows program. The results can be presented in the form of Table 2.

Table 2. Summary Table of the Second and Third Hypothesis Tests

Dependent Variable	Type III Sum of Squares	Df	Mean Square	F	Sig.
Critical thinking	910.578	1	910.578	10.827	0.002
Learning outcomes	985.082	1	985.082	21.901	0.000

Based on Table 2, it is known first that the sig. for critical thinking skills of 0.002. Sig score is smaller than 0.05. Thus, H0 is rejected, or there is a significant difference in students' critical thinking skills between groups of students who are taught using a hots-oriented problem-based model and a group of students who are not taught with a hots-oriented problem-based model for fifth grade SD Saraswati 3 Denpasar 2022/2023. Second, the sig. for learning outcomes of 0.000. The sig score is smaller than 0.05. Thus, H0 is rejected, or there is a significant difference in science learning outcomes between those who are taught using the HOTS-oriented problem-based model and students who are not taught with the HOTS-oriented problem-based model for fifth grade SD Saraswati 3 Denpasar 2022/2023.

Discussion

This study compares 1) science learning outcomes following the HOTS-oriented problem-based learning model with students who do not follow the HOTS-oriented problem-based learning model, 2) science critical thinking skills following the HOTS-oriented problem-based learning model with students who do not follow the HOTS-oriented problem-based learning model. HOTS-oriented problem-based learning, 3) Science learning outcomes and science critical thinking skills that follow the HOTS-oriented problem-based learning model with students who do not follow the HOTS-oriented problem-based learning model.

The results of data analysis regarding science learning outcomes and critical thinking skills showed an influence between students who were taught with the HOTS problem-oriented problem-based learning model and groups of students who were not taught with the HOTS problem-oriented problem-based learning model. Learning with the HOTS problem-oriented problem-based learning model can make students more interested in solving the problems they face. Learning using a problem-based learning model is oriented towards HOTS issues and requires the active involvement of students in solving them through the syntax of this model. Previous research explained the syntax of the PBL model, including 1) orientation to the problem. At this stage, students are given an overview of the objectives of the material to be learned and directed to the problem as the basis for starting learning, and 2) organizing students to learn. At this stage, learning is arranged in such a way so that students can study with their respective groups, 3) guide individual or group investigations, at this stage, students collect various information relevant to the problem given, 4) present their work, at this stage students present the results of their respective group work in front of the class. Other groups provide feedback or additions, and 5) analyze and evaluate problem-solving. At this stage, students reflect on the investigation and problem-solving process that has been carried out with the teacher's guidance so that students will understand the material being studied (Trianto, 2017). By the syntax of the problem-based learning model, there is

student organizing. Learning carried out in groups can increase student learning motivation, so they want to work with their group friends to overcome the problems they face (Fauzan et al., 2017; Simbolon, 2017). Other researchers also expressed that learning that prioritizes cooperative activities between students can increase student activity, foster self-will to learn, and train skills to work in groups (Santoso & Wulandari, 2020). Then it is also explained that the activeness of students in discussion and question and answer increases with the implementation of learning that emphasizes collaboration between students (Puspitasari, R. P., Sutarno, S., & Dasna, 2020).

This model has the advantage that students will have an open, reflective, critical, and active learning mindset and better facilitate the success of problem-solving, communication, group work, and interpersonal skills. The study results stated that learning with the PBL model made students actively seek their knowledge to solve the problems they found (Dianawati, N. L., Riastini, N., 2017; Yusri, 2018). Furthermore, in the PBL group, students can express their opinions. The results of previous studies argue that the Problem-Based Learning learning model is more effective than the problem-Solving learning model for critical thinking skills (Septiyowati, T., & Prasetyo, 2021).

Furthermore, the science learning outcomes of fifth-grade students who took the HOTS problem-oriented problem-based learning model had an average score higher than that of science learning outcomes that did not follow the HOTS problem-oriented problem-based learning model. The following things cause the difference in science learning outcomes. First, groups of students who take part in learning using a problem-based learning model are introduced to problem-finding learning. The existence of problems presented in the form of Student Worksheets makes students motivated to be involved in problem-solving (Djonomiarjo, 2020; Sukmasari & Rosana, 2017). Students seemed enthusiastic about participating in solving problems. Students also have the freedom and discretion to develop knowledge based on real life. Thus, students' understanding will increase so that student learning outcomes become better. Second, the stages of the problem-based learning model train students to learn to work systematically in the sense that students are taught to be involved in problem-solving by conducting discussions up to reporting the results of discussions on hot material and its transfer to improve students' natural science learning outcomes (Muhammad, R. Y., & Muhammad, 2017). The teacher only serves as a facilitator. For example, in the material on temperature and heat, students are invited to observe several pictures, then they relate them to each student's experiences. Which picture is a source of heat energy in everyday life so that students are encouraged to define the task of learning together with the group? It is also by the research results state that students get meaningful learning because the problems or material discussed are related to the environment around them (Santoso & Wulandari, 2020). With meaningful learning, students become more understanding of the material and not just remembering or memorizing the material.

Increasing students' critical thinking skills is also based on training students to solve a problem and present the results of discussions in front of the class. Students must actively participate in asking and responding to questions to develop their critical thinking skills, especially in giving simple explanations. Simple explanations include focusing on questions, analyzing arguments, and asking and answering questions. Previous research stated that learning that asks students to understand or formulate problems, goals, and hypotheses, make observations or investigations, search for data, and analyze to answer problems that have been formulated can develop students' critical thinking skills (Arifin, Samsul., Kartono dan Hidayah, 2019; Yulianti, E., & Gunawan, 2019). A similar opinion was also conveyed. The problem-based learning model is a good model to support students' higher-order thinking processes (Ilmiyatni et al., 2019). Furthermore, other studies mention that using problem-based learning models can improve students' critical thinking skills (Farisi et al., 2017).

This and other research differ in the Basic Competence and the themes developed. The theme developed in this study is theme 6 of temperature and heat in fifth grade. In addition, this research also has differences from other studies, which lie in the instruments used. The instrument used in this study was an essay instrument with ten items as many questions. In addition to having differences, this study also has drawbacks. The first drawback is being unable to measure critical thinking skills and learning outcomes in other themes.

4. CONCLUSION

Based on the analysis of the results of the research and discussion above, it can be concluded from all the results of this study: a) there are differences in science learning outcomes and critical thinking skills between students who take part in HOTS-oriented problem-based learning and students who do not take part in learning with the HOTS learning model HOTS-oriented problem-based. b) there are differences in science learning outcomes between students who take the HOTS-oriented problem-based

learning model and students who do not take the HOTS-oriented problem-based learning model. c) there are differences in the ability to think critically between students who take part in HOTS-oriented problem-based learning models and students who do not take part in HOTS-oriented problem-based learning models.

5. REFERENCES

Afandi, M., & Handayani, T. (2020). Penerapan Problem Based Learning (PBL) untuk Meningkatkan Higher Order Thinking Skills (HOTS) Ditinjau dari Hasil Belajar Mahasiswa pada Mata Kuliah Materi IPA MI. *JIP (Jurnal Ilmiah PGMI)*, *6*(1), 88–106. https://doi.org/https://doi.org/10.19109/jip.v6i1.4330.

Agnafia, D. N. (2019). Analisis Kemampuan Berpikir Kritis Siswa Dalam Pembelajaran Biologi. *Florea*, *6*(1), 5–10. https://doi.org/10.25273/florea.v6i1.4369.

Ambussaidi, I., & Yang, Y.-F. (2019). The Impact of Mathematics Teacher Quality on Student Achievement in Oman and Taiwan. *International Journal of Education and Learning*, *1*(2), 50–62. https://doi.org/10.31763/ijele.v1i2.39.

Anazifa, R. D., & Djukri, D. (2017). Project- Based Learning and Problem-Based Learning: Are They Effective to Improve Student's Thinking Skills? *Jurnal Pendidikan IPA Indonesia*, *6*(2), 346–355. https://doi.org/10.15294/jpii.v6i2.11100.

Antara, I. G. W. S., & Dewantara, K. A. K. (2022). E-Scrapbook: The Needs of HOTS Oriented Digital Learning Media in Elementary Schools. *Journal for Lesson and Learning Studies*, *5*(1), 71–76. https://doi.org/10.23887/jlls.v5i1.48533.

Arifin, Samsul., Kartono dan Hidayah, I. (2019). Analisis Kemampuan Pemecahan Masalah pada Model Problem Based Learning Disertai Remedial Teaching. *Eduma: Mathematics Education Learning and Teaching*, *8*(1), 85–97. https://doi.org/10.24235/eduma.v8i1.3355.

Arya, M. (2020). Instrumen penilaian motivasi belajar dan hasil belajar IPA siswa Kelas V Sekolah Dasar. *Mimbar Ilmu*, *25*(2), 262–270. https://ejournal.undiksha.ac.id/index.php/MI/article/view/26611.

Cik'ani. (2021). Meningkatkan Aktivitas Belajar Melalui Penerapan Model Problem Based Learning Dengan Berorientasi Pembelajaran High Order Thinking Skills Dan Keterampilan Abad 21 Siswa SMP. *Jurnal Inovasi Dan Riset Akademik*, *2*(5), 652–664. https://doi.org/https://doi.org/10.47387/jira.v2i5.129.

Dianawati, N. L., Riastini, N., P. (2017). Pengaruh Model Pembelajaran Problem Based Learning Terhadap Kemampuan Berpikir Kritis IPA Siswa Kelas 5 SD No. 1 Ungasan Kecamatan Kuta Selatan Tahun Pelajaran 2016/2017. *E-Journal PGSD Universitas Pendidikan Ganesha*, *5*(2), 1–9. https://doi.org/10.30997/dt.v7i1.2645.

Djonomiarjo, T. (2020). Pengaruh Model Problem Based Learning Terhadap Hasil Belajar. *Aksara: Jurnal Ilmu Pendidikan Nonformal*, *5*(1), 39–46. https://doi.org/10.37905/aksara.5.1.39-46.2019.

Fajriyah, K., & Agustini, F. (2018). Analisis Keterampilan Berpikir Tingkat Tinggi Siswa SD Pilot Project Kurikulum 2013 Kota Semarang. *Elementary School: Jurnal Pendidikan Dan Pembelajaran Ke-SD-An*, *5*(1). http://es.upy.ac.id/index.php/es/article/view/594/409.

Farhan, M., & Arisona, R. D. (2022). Problem Based Learning (PBL) Berorientasi Higher Order Thinking Skills (HOTS) Untuk Meningkatkan Hasil Belajar IPS. *PAKIS (Publikasi Berkala Pendidikan Ilmu Sosial)*, *2*(2). https://doi.org/https://doi.org/10.20527/pakis.v2i2.5861.

Farisi, A., Hamid, A., & Melvina, M. (2017). Pengaruh Model Pembelajaran Problem Based Learning terhadap Kemampuan Berpikir Kritis dalam Meningkatkan Hasil Belajar Siswa pada Konsep Suhu dan Kalor. *Jurnal Ilmiah Mahasiswa Pendidikan Fisika*, *2*(3), 283–287. https://doi.org/10.30997/dt.v7i1.2645.

Fathani, A. H. (2016). Pengembangan Literasi Matematika Sekolah dalam Perspektif Multiple Intelligences. *Edu Sains: Jurnal Pendidikan Sains Dan Matematika*, *4*(2). https://doi.org/https://doi.org/10.23971/eds.v4i2.524.

Fauzan, M., Gani, A., Syukri, M., Aceh, D. B., & Banda, D. (2017). Penerapan Model Problem Based Learning Pada Pembelajaran Materi Sistem Tata Surya Untuk Meningkatkan Hasil Belajar Siswa. *Jurnal Pendidikan Sains Indonesia (Indonesian Journal of Science Education)*, *5*(1), 27–35. http://www.e-repository.unsyiah.ac.id/JPSI/article/view/8404.

Grahito., W. A. (2020). Penyelenggaraan Pembelajaran Ipa Berbasis Pendekatan Stem Dalam Menyongsong Era Revolusi Industri 4.0. *LENSA (Lentera Sains): Jurnal Pendidikan IPA*, *10*(1), 54–62. https://doi.org/10.24929/lensa.v10i1.98.

Hadi, S., & Novaliyosi. (2019). TIMSS Indonesia (Trends in International Mathematics and Science Study). *Prosiding Seminar Nasional & Call For Papers*, 562–569. http://jurnal.unsil.ac.id/index.php/sncp/article/view/1096.

Helmon, A. (2018). Pengaruh Model Problem Based Learning (PBL) Terhadap Kemampuan Berpikir Kritis Siswa SD. *JIPD (Jurnal Inovasi Pendidikan Dasar)*, *2*(1), 38–52. https://jurnal.unikastpaulus.ac.id/index.php/jipd/article/view/254.

Huang, S.-Y., Kuo, Y.-H., & Chen, H.-C. (2020). Applying Digital Escape Rooms Infused with Science Teaching in Elementary School: Learning Performance, Learningnamely Motivation, and Problem-Solving Ability. *Journal Pre-Proof*, 1–46. https://doi.org/https://doi.org/10.1016/j.tsc.2020.100681.

Ilmiyatni, F., Jalmo, T., & Yolida, B. (2019). Penggunaan Problem Based Learning untuk Meningkatkan Keterampilan Kolaborasi Dan Berpikir Tingkat Tinggi. *Jurnal Bioterdidik: Wahana Ekspresi Ilmiah*, *7*(2), 35–45. http://jurnal.fkip.unila.ac.id/index.php/JBT/article/view/17480.

Imanuel, S. A. (2015). Kesulitan Belajar IPA Peserta Didik Sekolah Dasar. *Vox Edukasi*, *6*(2), 143–155. https://doi.org/https://doi.org/10.31932/ve.v6i2.106.

Juniati, N. W., & Widiana, I. W. (2017). Penerapan Model Pembelajaran Inkuiri Untuk Meningkatkan Hasil Belajar IPA. *Journal Ilmiah Sekolah Dasar*, *1*(1), 20–29. https://doi.org/10.23887/jisd.v1i1.10126.

Lavi, R., Tal, M., & Dori, Y. J. (2021). Perceptions of STEM Alumni and Students on Developing 21st Century Skills Through Methods Of Teaching and Learning. *Studies in Educational Evaluation*, *70*, 1–11. https://doi.org/https://doi.org/10.1016/j.stueduc.2021.101002.

Makhrus, M., Harjono, A., Syukur, A., Bahri, S., & Muntari. (2018). Analisis Rencana Pelaksanaan Pembelajaran (RPP) Terhadap Kesiapan Guru Sebagai "Role Model" Keterampilan Abad 21 Pada Pembelajaran IPA SMP. *Jurnal Penelitian Pendidikan IPA*, *5*(1). https://doi.org/10.29303/jppipa.v5i1.171.

Muhammad, R. Y., & Muhammad, W. S. (2017). Pengembangan Problem Based Learning dengan Assessment for Learning Berbantuan Smartphone dalam Pembelajaran Matematika. *Beta Jurnal Tadris Matematika*, *10*(2), 184–202. https://doi.org/http://dx.doi.org/10.20414/betajtm.v10i2.116.

Mutakinati, L., Anwari, I., & Yoshisuke, K. (2018). Analysis of students' critical thinking skill of middle school through stem education project-based learning. *Jurnal Pendidikan IPA Indonesia*, *7*(1), 54–65. https://doi.org/10.15294/jpii.v7i1.10495.

Narut, Y. F., & Supradi, K. (2019). Literasi sains peserta didik dalam pembelajaran ipa di indonesia. *Jurnal Inovasi Pendidikan Dasar*, *3*(1), 61–69. http://jurnal.unikastpaulus.ac.id/index.php/jipd/article/view/214.

Nitko, A. J. & S. M. B. (2011). *Educational Assessment of Students (6th Edition)*. Pearson Education Inc.

Nugraha, A. J., Suyitno, H., & Susilaningsih, E. (2017). The Effect of Problem Based Learning model on students' Critical Thinking Skills, Science Process Skills, and Motivation in Elementary School. *Journal of Primary Education*, *6*(1), 35–43. https://journal.unnes.ac.id/sju/index.php/jpe/article/download/14511/8285.

Nugroho, A. N., & Airlan, G. . (2020). Pengembangan Instrumen Penilaian Keterampilan Berpikir Kritis Pembelajaran IPA Kelas 4 SD. *Jurnal Ilmiah Pendidikan Profesi Guru*, *3*(3), 400–407. https://ejournal.undiksha.ac.id/index.php/JIPPG/article/view/29712.

Oktaviana, Y. I., & Rosyidi, A. H. (2019). Kemampuan Siswa dalam Menyelesaikan Soal PISA Kategori Formulate pada Siswa Kelas VIII. *MATHEdunesa: Jurnal Ilmiah Pendidikan Matematika*, *8*(2), 400–407. https://doi.org/10.26740/mathedunesa.v8n2.p400-407.

Pratiwi, A., & Asyarotin, E. N. K. (2019). Implementasi literasi budaya dan kewargaan sebagai solusi disinformasi pada generasi millennial di Indonesia. *Jurnal Kajian Informasi & Perpustakaan*, *7*(1), 65–80. https://doi.org/10.24198/jkip.v7i1.20066.

Pratiwi, S. N., Cari, C., & Aminah, N. S. (2019). Pembelajaran IPA Abad 21 dengan Literasi Sains Siswa. *Jurnal Materi Dan Pembelajaran Fisika (JMPF)*, *9*(1), 34–42. https://doi.org/10.20961/jmpf.v9i1.31612.

Puspitasari, R. P., Sutarno, S., & Dasna, I. W. (2020). Pengaruh Model Problem Based Learning terhadap Kemampuan Berpikir Tingkat Tinggi dan Hasil Belajar Siswa Kelas V SD. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan*, *5*(4), 503–511. https://doi.org/http://dx.doi.org/10.17977/jptpp.v5i4.13371.

Rovers, S. F. E., Clarebout, G., Savelberg, H. H. C. M., & van Merriënboer, J. J. G. (2018). Improving Student Expectations of Learning in a Problem-Based Environment. *Computers in Human Behavior*, *87*, 416–423. https://doi.org/https://doi.org/10.1016/j.chb.2018.02.016.

Santoso, B., & Wulandari, F. E. (2020). Pengaruh Pembelajaran Berbasis Proyek Dipadu Dengan Metode Pemecahan Masalah Pada Keterampilan Berpikir Kreatif Siswa Dalam Pembelajaran IPA. *Journal of Banua Science Education*, *1*(1). https://doi.org/10.20527/jbse.v1i1.3.

Septiyani, E., Ramdhan, B., & Juhanda, A. (2020). Profil Kemampuan Metakognitif Siswa Pada Pembelajaran Ipa Kelas Vii Di Smpn 13 Kota Sukabumi. *Jurnal Biotek*, *8*(1), 1. https://doi.org/10.24252/jb.v8i1.13356.

Septiyowati, T., & Prasetyo, T. (2021). Efektivitas Model Pembelajaran Problem Based Learning Dan Discovery Learning Terhadap Kecakapan Berfikir Kritis Siswa Sekolah Dasar. *Jurnal Basicedu*, *5*(3), 1231–1240. https://doi.org/https://doi.org/10.31004/basicedu.v5i3.893.

Sianturi, A., Sipayung, T. N., & Simorangkir, F. M. A. (2018). Pengaruh Model Problem Based Learning (PBL) terhadap Kemampuan Berpikir Kritis Matematis Siswa SMPN 5 Sumbul. *UNION: Jurnal Ilmiah Pendidikan Matematika*, *6*(1). https://doi.org/https://doi.org/10.30738/.v6i1.2082.

Simbolon, M. (2017). Penerapan Model Pembelajaran Kooperatif dalam Meningkatkan Motivasi Serta Kreativitas dan Hasil Belajar Siswa di SMP Negeri 5 Tebing Tinggi. *School Education Journal PGSD FIP UNIMED*, *7*(3), 353–362. https://doi.org/https://doi.org/10.24114/sejpgsd.v7i3.9259 Article Metrics.

Sudana, I. P. A., & Wesnawa, I. G. A. (2017). Penerapan Model Pembelajaran Kooperatif Tipe Stad Untuk Meningkatkan Hasil Belajar Ipa Siswa Kelas Ii Sekolah Dasar. *Jurnal Ilmiah Sekolah Dasar*, *1*(1), 1–8. https://doi.org/10.33578/jpfkip.v7i1.5359.

Sukmasari, V. P., & Rosana, D. (2017). Pengembangan Penilaian Proyek Pembelajaran IPA Berbasis Discovery Learning untuk Mengukur Keterampilan Pemecahan Masalah. *Jurnal Inovasi Pendidikan IPA*, *3*(1), 101–110. https://doi.org/10.21831/jipi.v3i1.10468.

Sung, E. (2017). The Influence of Visualization Tendency On Problem-Solving Ability And Learning Achievement Of Primary School Students in South Korea. *Thinking Skills and Creativity Journal*, *26*, 168–175. https://doi.org/https://doi.org/doi:10.1016/j.tsc.2017.10.

Trianto. (2017). *Mendesain Model Pembelajaran Inovatif, Progresif dan Kontektual*. Kencana.

Tyas, R. A., Wilujeng, I., & Suyanta, S. (2020). Pengaruh Pembelajaran IPA Berbasis Discovery Learning Terintegrasi Jajanan Lokal Daerah terhadap Keterampilan Proses Sains. *Jurnal Inovasi Pendidikan IPA*, *6*(1), 114–125. https://doi.org/10.21831/jipi.v6i1.28459.

Wahyuni, S., & Anugraheni, I. (2020). Pengaruh Model Problem Based Learning Terhadap Kemampuan Berpikir Kritis Siswa Kelas IV dalam Pembelajaran Tematik. *Magistra: Jurnal Keguruan Dan Ilmu Pendidikan*, *7*(2), 73–82. https://garuda.kemdikbud.go.id/documents/detail/2112283.

Wahyuni, G., Ibnu, S., & Suharti, S. (2019). Perbedaan Pemahaman Konsep Siswa sebagai Hasil Penerapan Model Pembelajaran LC 5E-Analogi dan LC 5E. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan*, *4*(4), 537. https://doi.org/10.17977/jptpp.v4i4.12361.

Yulianti, E., & Gunawan, I. (2019). Model Pembelajaran Problem Based Learning (PBL): Efeknya terhadap Pemahaman Konsep dan Berpikir Kritis. *Indonesian Journal of Science and Mathematics Education*, *2*(3), 399–408. https://doi.org/10.24042/ijsme.v2i3.4366.

Yusri, Y. (2018). Pengaruh Pembelajaran Problem Based Learning (PBL) Terhadap Aktivitas Belajar Siswa pada Pembelajaran IPA Kelas VII SMPN 4 Aikmel. *Cocos Bio*, *3*(1), 9–16. http://e-journal.hamzanwadi.ac.id/index.php/cob/article/view/2928.