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The Effect of Cognitive Ability in Problem-Based Learning on Science Literacy Ability of Grade 4 Elementary School Students

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ABSTRACT

This research and development are motivated by the low cognitive ability of learners and followed by low levels of science literacy of science participants. The study's goal was to find out if there was a direct influence on students' cognitive and science literacy abilities. The method in this study is in the form of a test method with an ex-post-facto research design. This research has been done at Sumberagung State Elementary School Yogyakarta with 4th grade A research subjects totaling 32 students. A simple regression technique functioned to analyze the data inferentially. Through a simple regression test, the results of F count = 10,585 and p-value = 0.003 < 0.05 or H0 are rejected. Thus regression Y over X is a significant cognitive ability to affect a student's science literacy. The coefficient of determination obtained the value R Square = 0.274, which means that students' cognitive ability can influence 27.4% variation in the variable science literacy ability. At the same time, 72.6% of science literacy ability was affected by other variables that were not studied. Other factors can affect the science literacy ability of learners. The researcher hopes that further research can improve this research.

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1. INTRODUCTION

Scientific literacy is one of the primary skills needed in the current digital era (Fakhriyah et al., 2017). We are currently facing the digital era in the 21st century. In the 21st century, science and technology are developing rapidly. In the digital age, various problems arise related to science and technology (De et al., 2020). When solving the existing problems, it is necessary to empower each individual to decide to participate personally in public policy-making influence on the lives of individuals (Pirannejad & Janssen, 2019). At the same time, these problems are a challenge for education in the 21st century.

Scientific literacy is a skill used to understand and apply scientific concepts in solving scientific problems and problems that occur in real life (Primasari et al., 2020). The importance of scientific literacy skills in the 21st century is because this ability can help individuals utilize the knowledge and skills to solve problems around them (Frydenberg & Andone, 2011). Applying the knowledge and skills possessed can help individuals determine the steps to be taken when there is a problem (Darling-Hammond et al., 2020).

Scientific literacy is the ability to use knowledge, identify questions, and draw conclusions based on evidence to understand the surrounding environment (Chusni et al., 2020). This understanding makes natural decisions and changes through human activities (Windyariani & Amalia, 2019). Literacy intends to identify its problems scientifically to find out the problem and determine attitudes and steps to be taken (Dragoş & Mih, 2015). Individuals with scientific literacy skills generally identify issues and solve them in a scientifically responsible way.

Individuals with scientific literacy skills can solve problems using scientific concepts obtained in education based on their level (Adnan et al., 2021). Individuals will be able to recognize knowledge from the surrounding technology and its positive impact and use the knowledge they have. Creativity in creating useful new technologies is in this knowledge (Fakhriyah et al., 2017). The Program Internationale for Student Assessment evaluates abilities and expertise in several developed and developing countries, given the importance of scientific literacy.

The PISA assessment every three years began in 2000. The areas of research and research evaluation include reading literacy, mathematics literacy and scientific literacy (OECD, 2019). The results of the PISA study from 2000 to 2015 show that Indonesia's ranking continues to increase. In 2015, the scientific literacy of Indonesian students ranked 69th among 76 countries with a score of 403 (OECD, 2017). Although it has improved, it is still far below the international average score set by PISA.

The results of the annual survey in 2015, a test conducted on 15-year-old students in scientific literacy, Indonesia, obtained a score of 403. This score is low because it is still lower than the average score of 493 for all participating countries of the Organization for Economic Cooperation and Development. (OECD, 2017). This score is because the questions used in PISA cover six cognitive aspects of cognitive processes (Farida, 2016). Therefore, we know that the cognitive abilities of Indonesian students are still lower than the average level of other OECD countries.

The average score of Indonesia is still relatively low, reflecting that most students in Indonesia have not been able to analyze and apply knowledge concepts to solve problems. Several factors cause low scientific literacy in Indonesia, namely gender, economy and society, and immigration (Windyariani & Amalia, 2019). Other factors that contribute to the standard scientific literacy of Indonesian students include an inappropriate selection of textbooks, wrong understanding, non-contextual learning, low reading skills, cognitive abilities, and an environment that is not conducive to learning (Fuadi et al., 2020).

Cognitive ability is one factor that influences an individual's level of scientific literacy (Howell & Brossard, 2021). Cognitive ability is related to the mastery of science (Kruit et al., 2018). Cognitive abilities emphasize students' abilities in science in the form of facts, concepts, principles, and procedures. Students' cognitive abilities can be analyzed using tests containing cognitive questions. What learning steps will the teacher do next after analyzing students' cognitive abilities to find out students' thinking process abilities (Nabilah et al., 2020).

The thinking process of students is not directly observed based on their behavior. Still, their cognitive abilities can show from the type and quality of the response given when facing a problem or question (Pitriani et al., 2019). Cognitive skills, according to Piaget, a person's cognitive abilities will continue to change along with interactions with other people and problem-solving efforts. When someone has succeeded in solving one problem, their success will use that success to solve different issues that are similar or at a more complicated level (Hanafi & Sumitro, 2020).

Thus, the more often children interact with the surrounding environment, the more they encounter problems. Solving one issue will be used as a reference for solving other problems. In this case, cognitive development occurs according to the problem at hand. This cognitive development follows scientific literacy, that is, as a way of thinking, investigating, knowledge systems and interacting with technology and society. (Rosa et al., 2021).

Based on research conducted by Hanafi, cognitive development in children shows the result of the way children think. A measuring tool for children's cognitive development is the ability of a child to relate various ways of thinking in the context of solving a problem can (Hanafi & Sumitro, 2020).

Problem-solving as a measuring tool for cognitive abilities can act as if the use of cognitive abilities to solve problems scientifically or can be called scientific literacy.

Jufrida's research results explain that in science learning, which only relies on material memory, students have not been able to understand and master the concepts of science learning. This disability makes students' cognitive abilities decrease. This research states that the low cognitive ability affects students' scientific literacy, which also reduces (Jufrida et al., 2019).

According to research conducted by Lestari, scientific literacy has a positive effect on students' cognitive abilities. Lestari emphasizes that the emphasis on scientific literacy is not only knowledge and understanding of scientific concepts and processes but also how one can make decisions and participate in social life, culture, and economic growth (Lestari, 2017).

To sharpen students' scientific literacy skills through learning activities such as identifying scientific questions, providing scientific explanations of phenomena, and using scientific evidence. According to Syamsurizal's research, scientific literacy significantly affects students' cognitive abilities. The concept of science literacy-oriented learning makes students think scientifically about the evidence that will be faced by students in the next life (Siswono, 2017).

In this study, in addition to knowing the effect of cognitive abilities on students' scientific literacy skills, researchers want to know the extent to which students' cognitive abilities influence the development of students' scientific literacy abilities. Thus, the researchers tried to uncover how the influence of cognitive abilities on the scientific literacy abilities of 4th-grade elementary school students.

Researchers suspect that students' cognitive abilities have a relationship or influence on scientific literacy skills in applying their knowledge to identify and solve problems in the surrounding environment. The purpose of this research is to determine whether students' cognitive abilities have a direct impact on students' scientific literacy skills.

2. METHODS

The method in this research is a mixed methods with with a post-mortem research design, because this research involves variables that have occurred and has nothing to do with the variables studied (Khairuna et al., 2021). The research was conducted at Sumberagung elementary school Yogyakarta. The research subjects were all fourth-grade students for 2021/2022, and the research sample was grade 4A students.

Researchers took 32 students as research subjects. In extracting data, the researcher gave a test consisting of a cognitive test and a scientific literacy test. Each of these variables consists of 10 questions—the question to students without giving any treatment. This study uses the Windows program SPPS 24 for statistical analysis to use simple regression analysis to test the hypothesis.

The data analysis technique is the method used to prove the hypothesis. In this study, the data analysis technique used is inference analysis. The reasoning analysis used a simple regression technique. Research hypotheses about the relationship between variables X and Y using inferential statistics. Inferential statistics is a statistical technique used to analyze sample data. The results of the analysis will be generalized to the population.

Researchers also want to know how much cognitive ability affects students' scientific literacy. To determine the size of this effect, the researcher used SPSS 24 for Window to perform a simple regression test and analyze the size of R Square. the measurement test gives the results of the value of R square. Then match the number of R squares with the percentage of the effect of cognitive ability on scientific literacy (Sherkat, 2011).

3. RESULTS AND DISCUSSION

Data Description

In the cognitive ability variable, data is obtained from the distribution of the frequency distribution and then statistically processed into frequency distribution data starting from the data on the number of classes, mean, median, and mode. The formula used is the Sturges formula ($K = 1 + 3.3 \log n$) thus obtained six classes with the lowest score of 60 and the highest score of 95, the mode value for the

scientific approach variable is 80, while the median value is 75 and the mean value is 73.16. The standard deviation or standard deviation obtained is 9.14.

Meanwhile, for the scientific literacy variable, data is obtained from the distribution of the frequency distribution and then statistically processed into frequency distribution data starting from the data on the number of classes, mean, median, and mode. The formula used is the Sturges formula (K = 1 + 3.3 log n) thus obtained six classes with the lowest score of 65 and the highest score of 95, the mode value for the scientific approach variable is 80, while the median value is 80 and the mean value is 79.34. The standard deviation or standard deviation obtained is 6.39.

Inferential Statistical Analysis Results

In the normality test of this study using the Kolmogorov-Smirnov, sig. Normality showed the result of cognitive ability 0.143, and scientific literacy showed the result of 0.020. cognitive ability and scientific literacy have a significance > 0.05. All data proved normal so that the analysis could be processed. The significance value obtained by the linearity test is 0.304. If the linear value is greater than 0.05, it can be concluded that there is a significant linear relationship between cognitive ability variables and scientific literacy variables.

The regression test results can be presented in table 1 as follows.

Table 1. Simple regression test

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	325.529	1	325.529	10.585	.003b
	Residual	861,138	28	30,755		
	Total	1186667	29			

a. Dependent Variable: scientific literacy
b. Predictors: (Constant), scientific literacy

Statistical hypothesis:
H0: = 0 (meaningless regression)
H1: 0 (regression means)

The simple regression test was obtained from the value of Fcount = 10.585 and p-value = 0.003 <0.05 or H0 was rejected. Thus the regression Y over X is significant or cognitive ability affects students' scientific literacy.

The test results prove that cognitive ability significantly influences students' scientific literacy. It can conclude that good cognitive abilities will most likely affect students with good scientific literacy. Students active in learning activities have a better experience and ability to utilize knowledge to develop cognitive abilities. Students actively respond and research many things to help master the problem or material when the learning process occurs. Students use their cognitive abilities to analyze and make decisions about using their knowledge in responding and utilizing this knowledge.

Table 2. Test of determination

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.524a	.274	.248	5.54571

a. Predictors: (Constant), scientific literacy

The judgment test results in Table 2 show that the judgment coefficient is R-squared = 0.274, which means that students' cognitive ability can affect the 27.4% variation of the variables of scientific literacy ability. At the same time, 72.6% of scientific literacy ability is affected by other untested variables.

Cognitive ability is the ability of students to master the cognitive domain. The cognitive domain based on Bloom's revised taxonomy includes behaviors that emphasize intelligence, such as knowledge and thinking skills, including memory, understanding, application, analysis, evaluation, and creation (Nabilah et al., 2020).

These cognitive abilities become the initial foundation for students to master other abilities (Susilowati P. J., 2018). Cognitive ability is a cumulative development. Cumulative development means that mastered developments first will be the basis for further developments. Therefore, it will inhibit students' development of other abilities, hamper if cognitive development.

According to Piaget, a person with cognition behavior, namely the act of recognizing or thinking about the conditions. Therefore, the child's personality will be formed indirectly through the learning process, including a very complex thought process is a psychological event that encourages attitudes and behavior. Learning science can stimulate cognitive structures to develop reasoning abilities (Juwantara, 2019). Therefore, the level of readiness of cognitive structures and developing reasoning abilities in learning science.

Cognitive development can affect scientific literacy is one of development. Scientific literacy is the ability to use science to solve problems in daily life to understand scientific concepts and processes (Sutrisna, 2021). According to PISA (International Student Assessment Program), scientific literacy is the ability to apply scientific knowledge, discover problems, and draw conclusions based on scientific evidence to understand the changes caused by natural and human activities and make decisions (OECD, 2017).

Various internal and external factors influence scientific literacy. Factors that influence scientific literacy include the selection of teaching materials, cognitive misconceptions, low reading skills, non-contextual learning, and the learning environment (Fuadi et al., 2020). Of these various factors, misconceptions have an important influence on students' scientific literacy skills. The misconception is an error or incompatibility of the concept with the scientific understanding accepted by experts (Yuliati, 2017).

The reasons for the misunderstandings experienced by students can be from the students themselves. The stage of development of inconsistent perceptions of learning, students' reasoning limitations and errors, the ability of students to capture and understand concepts, apply what they have learned, students' interest in learning the concepts being taught (Nugroho et al., 2019). Thus, students' low cognitive abilities can be one of the effects of misconceptions.

Students' cognitive abilities affect students' conceptual understanding abilities (Novitasari & Pujiastuti, 2020). Good cognitive abilities will make it easier for students to understand their learning concepts. On the other hand, the low cognitive ability of students fails in understanding scientific concepts from the learning. Thus, understanding the concept of science as the initial basis for scientific literacy is influenced by students' cognitive abilities.

Scientific literacy is the ability to use knowledge to solve science-related problems (Kristyowati & Purwanto, 2019). Adequate knowledge must exist in the process of utilizing knowledge. Sufficient knowledge comes from cognitive abilities that can accommodate knowledge cumulatively. Thus, students' cognitive abilities affect students' scientific literacy skills.

Therefore, to improve students' scientific literacy, it is necessary to increase student's cognitive abilities. Improving cognitive abilities can improve students' understanding of concepts (Kurino, 2019). Improving cognitive abilities will be the basis for growing students' scientific literacy. To improve students' cognitive abilities, teachers need to analyze students' cognitive abilities.

The use of problem-based learning models can be used to hone students' cognitive abilities. Problem-based learning is learning by exposing students to a problem/problem to be solved or resolved open conceptual problems in learning (Hotimah, 2020). Problem Based Learning is one of the learning models that can help students improve the skills needed in today's globalization era. Using the Problem Based Learning model aims to increase students' creativity to think critically and creatively in the learning process (Saragi & Makharany, 2022).

Problem-based learning begins by presenting problems to students. The teacher can immediately invite students to analyze the problem. Analysis of these problems will lead to learning motivation based on issues. Next, students work in small groups to discuss problem scenarios. In group work activities, students can discuss with each other and make suggestions to understand the problems that arise.

Then the next stage is literacy, from independence and collaboration to solve problems so that new knowledge is obtained. Learners are free, work together and collaborate to solve problems to obtain appropriate alternative solutions. The solutions found are then presented and evaluated. Problem-based learning steps can accommodate the needs of students' cognitive abilities (Palennari, 2018).

Problem-based learning models can improve critical thinking skills and develop potential. Students are more motivated to learn to obtain maximum results in the learning process (Amin et al., 2020). Problem-based learning is the development of thinking skills and problem-solving that is carried out through learning. Not only that, but students also need to be guided so that they can solve problems, find solutions for themselves and try to realize their ideas so that students can understand and apply their knowledge (Syawaly & Hayun, 2020).

Problem-based learning models are very influential on student learning outcomes, such as students being able to think critically more actively, creatively, and able to solve problems. The advantages of problem-based learning include the following; Students are required to be able to solve problems in actual conditions. Students can see their abilities. Students are accustomed to adapting to technology, so the problem-based learning model is appropriate for the learning process (Mustofa et al., 2016).

Analyzing students' cognitive abilities is very helpful to understand the realization of learning outcomes and the level of realization of students' cognitive abilities (Nasution & Casmini, 2020). Analyzing cognitive abilities is expected to help teachers understand the degree of cognitive ability and understanding of how high student achievement is. This analysis activity also makes it easier for teachers to improve students' cognitive abilities in finding solutions to achieve maximum student cognitive abilities.

To improve the quality of students, teachers can design learning in the classroom to improve cognitive abilities. Scientific learning must be balanced by asking assessment questions, encouraging students to develop thinking skills, and growing students' reasoning skills in certain situations (Gunawan et al., 2014). In addition, mastery of scientific material lies in thinking and thinking as a guide scientific assessment.

4. CONCLUSION

Students' cognitive abilities affect students' scientific literacy skills. The cognitive ability affects the ability to understand the concept of the material they are studying. Scientific literacy is the ability to use knowledge in solving problems faced by students who require an understanding of the correct initial concepts. Using the correct concept of knowledge will result in good scientific literacy of students. In 21st-century life, scientific literacy skills will be necessary, and student learning activities should improve cognitive abilities and scientific. Teachers as facilitators in learning need to know ways to develop cognitive abilities to improve students' scientific literacy. In particular, this research can only reveal the effect of students' cognitive abilities in problem-based learning on students' literacy abilities. The scientific literacy ability test in this study only measured the dimensions of content, context, and process dimensions by not giving any treatment, so the factors that supported or hindered the achievement of scientific literacy were not known. To complement the shortcomings of this study, future researchers can uncover other factors that affect students' scientific literacy skills.

REFERENSI

Adnan, Mulbar, U., Sugiarti, & Bahri, A. (2021). Scientific literacy skills of students: Problem of biology teaching in junior high school in South Sulawesi, Indonesia. *International Journal of Instruction*, *14*(3), 847–860. https://doi.org/10.29333/iji.2021.14349a

Amin, S., Utaya, S., Bachri, S., Sumarmi, & Susilo, S. (2020). Effect of problem-based learning on critical thinking skills and environmental attitude. *Journal for the Education of Gifted Young Scientists*, *8*(2), 743–755. https://doi.org/10.17478/jegys.650344

Chusni, M. M., Saputro, S., Suranto, & Rahardjo, S. B. (2020). The potential of discovery learning models to empower students' critical thinking skills. *Journal of Physics: Conference Series*, *1464*(1). https://doi.org/10.1088/1742-6596/1464/1/012036

Darling-Hammond, L., Flook, L., Cook-Harvey, C., Barron, B., & Osher, D. (2020). Implications for educational practice of the science of learning and development. *Applied Developmental Science*, *24*(2), 97–140. https://doi.org/10.1080/10888691.2018.1537791

De, R., Pandey, N., & Pal, A. (2020). Impact of digital surge during Covid-19 pandemic: A viewpoint on research and practice. *International Journal of Information Management*, *January*.

Dragoş, V., & Mih, V. (2015). Scientific Literacy in School. *Procedia - Social and Behavioral Sciences*, *209*(July), 167–172. https://doi.org/10.1016/j.sbspro.2015.11.273

Fakhriyah, F., Masfuah, S., Roysa, M., Rusilowati, A., & Rahayu, E. S. (2017). Student's science literacy in the aspect of content science? *Jurnal Pendidikan IPA Indonesia*, *6*(1), 81–87. https://doi.org/10.15294/jpii.v6i1.7245

Farida, A. (2016). Urgensi Perkembangan Motorik Kasar Pada Perkembangan Anak Usia Dini. *Jurnal Raudhah*, *IV*(2).

Frydenberg, M., & Andone, D. (2011). Learning for 21 st Century Skills. *International Conference on Information Society, i-Society 2011*, 314–318. https://doi.org/10.1109/i-society18435.2011.5978460

Fuadi, H., Robbia, A. Z., Jamaluddin, J., & Jufri, A. W. (2020). Analisis Faktor Penyebab Rendahnya Kemampuan Literasi Sains Peserta Didik. *Jurnal Ilmiah Profesi Pendidikan*, *5*(2), 108–116. https://doi.org/10.29303/jipp.v5i2.122

Gunawan, I., Suraya, S., & Tryanasari, D. (2014). Hubungan kemampuan berpikir kreatif dan kritis. *Premiere Educandum*, *4*(1), 10–40.

Hanafi, I., & Sumitro, E. A. (2020). Perkembangan Kognitif Menurut Jean Piaget Dan Implikasinya Dalam Pembelajaran. *Alpen: Jurnal Pendidikan Dasar*, *3*(2). https://doi.org/10.24929/alpen.v3i2.30

Hotimah, H. (2020). Penerapan Metode Pembelajaran Problem Based Learning Dalam Meningkatkan Kemampuan Bercerita Pada Siswa Sekolah Dasar. *Jurnal Edukasi*, *7*(3), 5. https://doi.org/10.19184/jukasi.v7i3.21599

Howell, E. L., & Brossard, D. (2021). (Mis)informed about what? What it means to be a science-literate citizen in a digital world. *Proceedings of the National Academy of Sciences of the United States of America*, *118*(15), 1–8. https://doi.org/10.1073/pnas.1912436117

Jufrida, J., Basuki, F. R., Pangestu, M. D., & Djati Prasetya, N. A. (2019). Analisis Faktor Yang Mempengaruhi Hasil Belajar Ipa Dan Literasi Sains Di Smp Negeri 1 Muaro Jambi. *EduFisika*, *4*(02), 31–38. https://doi.org/10.22437/edufisika.v4i02.6188

Juwantara, R. A. (2019). Analisis Teori Perkembangan Kognitif Piaget pada Tahap Anak Usia Operasional Konkret 7-12 Tahun dalam Pembelajaran Matematika. *Al-Adzka: Jurnal Ilmiah Pendidikan Guru Madrasah Ibtidaiyah*, *9*(1), 27. https://doi.org/10.18592/aladzkapgmi.v9i1.3011

Khairuna, K., Rahmatan, H., Sarong, M. A., Supriatno, S., & Pada, A. U. T. (2021). Penerapan Model Discovery Learning dengan Pemanfaatan Virtual Laboratory untuk Meningkatkan Keterampilan Proses Sains dan Hasil Belajar Peserta Didik pada Materi Sistem Ekskresi. *Jurnal Pendidikan Sains Indonesia*, *9*(2), 280–292. https://doi.org/10.24815/jpsi.v9i2.18875

Kristyowati, R., & Purwanto, A. (2019). Pembelajaran Literasi Sains Melalui Pemanfaatan Lingkungan. *Scholaria: Jurnal Pendidikan Dan Kebudayaan*, *9*(2), 183–191. https://doi.org/10.24246/j.js.2019.v9.i2.p183-191

Kruit, P. M., Oostdam, R. J., van den Berg, E., & Schuitema, J. A. (2018). Assessing students' ability in

performing scientific inquiry: instruments for measuring science skills in primary education. *Research in Science and Technological Education*, *36*(4), 413–439. https://doi.org/10.1080/02635143.2017.1421530

Kurino, Y. D. (2019). *Enhancing Students ' Cognitive Abilities Through Predict Observe Explain*. *4*(1), 1–6.

Lestari, I. D. (2017). Pengaruh literasi sains terhadap kemampuan kognitif siswa pada konsep ekosistem. *Prosiding Seminar Nasional Pendidikan FKIP UNTIRTA 2017*, 103–106.

Mustofa, Z., Susilo, H., & Muhdhar, M. (2016). Penerapan Model Pembelajaran Problem Based Learning Melalui Pendekatan Kontekstual Berbasis Lesson Study Untuk Meningkatkan Kemampuan Memecahkan Masalah Dan Hasil Belajar Kognitif Siswa Sma. *Jurnal Pendidikan - Teori, Penelitian, Dan Pengembangan*, *1*(5), 885–889.

Nabilah, M., Sitompul, S. S., & Hamdani, H. (2020). Analisis Kemampuan Kognitif Peserta Didik Dalam Menyelesaikan Soal Momentum Dan Impuls. *Jurnal Inovasi Penelitian Dan Pembelajaran Fisika*, *1*(1), 1. https://doi.org/10.26418/jippf.v1i1.41876

Nasution, U., & Casmini, C. (2020). Integrasi Pemikiran Imam Al-Ghazali & Ivan Pavlov Dalam Membentuk Prilaku Peserta Didik. *INSANIA : Jurnal Pemikiran Alternatif Kependidikan*, *25*(1), 103–113. https://doi.org/10.24090/insania.v25i1.3651

Novitasari, D., & Pujiastuti, H. (2020). Analisis Pemahaman Konsep Mahasiswa Pada Materi Analisis Real Berdasarkan Taksonomi Bloom Ditinjau Dari Ranah Kognitif. *Maju*, *7*(2), 153–163.

Nugroho, D. M., Utomo, S. B., & Hastuti, B. (2019). Identifikasi Miskonsepsi pada Materi Asam Basa Menggunakan Tes Diagnostik Two-Tier dengan Model Mental pada Siswa Kelas XII MIPA SMA N 1 Sragen Tahun Ajaran 2018/2019. *Jurnal Pendidikan Kimia*, *8*(2), 244. https://doi.org/10.20961/jpkim.v8i2.28246

OECD. (2017). PISA 2015 Results (Volume III): Students' Well-Being. In *Oecd: Vol. III*. https://www.oecd-ilibrary.org/education/pisa-2015-results-volume-iii_9789264273856-en

OECD. (2019). PISA 2021 creative thinking framework. *Oecd*, *53*(9), 1689–1699. https://www.oecd.org/pisa/publications/PISA-2021-creative-thinking-framework.pdf

Palennari, M. (2018). Problem Based Learning (PBL) Memberdayakan Keterampilan Berpikir Kritis Pebelajar Pada Pembelajaran Biologi Problem Based Learning (PBL) Empowering Student Critical Thinking Skills at Biological Learning. *Proseding Seminar Biologi Dan Pembelajarannya*, *2008*, 599–608.

Pirannejad, A., & Janssen, M. (2019). Internet and political empowerment: Towards a taxonomy for online political empowerment. *Information Development*, *35*(1), 80–95. https://doi.org/10.1177/0266666917730118

Pitriani, P., Widiyowati, I. I., & Usman, U. (2019). Analisis Kemampuan Kognitif Siswa Dalam Menyelesaikan Permasalahan Berdasarkan Indikator Taksonomi Solo yang Diajar Dengan Model Problem Based Instruction. *Bivalen: Chemical Studies Journal*, *2*(2).

Primasari, R., Miarsyah, M., & Rusdi, R. (2020). Science literacy, critical thinking skill, and motivation: A correlational study. *JPBI (Jurnal Pendidikan Biologi Indonesia)*, *6*(2), 273–282. https://doi.org/10.22219/jpbi.v6i2.11124

Rosa, A., Ambarita, A., Sabdaningtyas, L., & Yulianti, D. (2021). Development of Discovery Learning - Based Science Supplementary Textbooks to Improve Students ' Creative Thinking. *Al-Ishlah: Jurnal Pendidikan*, *13*(December).

Saragi, L., & Makharany, D. (2022). Pengaruh model pembelajaran problem based learning dengan menggunakan powerpoint terhadap hasil dan minat belajar siswa pada materi laju reaksi di kelas XI SMA. *Educenter : Jurnal Ilmiah Pendidikan*, *1*(4), 353–361. https://doi.org/10.55904/educenter.v1i4.108

Sherkat, D. E. (2011). Religion and Scientific Literacy in the United States. *Social Science Quarterly*, *92*(5), 1134–1150. https://doi.org/10.1111/j.1540-6237.2011.00811.x

Siswono, H. (2017). Analisis Pengaruh Keterampilan Proses Sains Terhadap Penguasaan Konsep Fisika Siswa. *Momentum: Physics Education Journal*, *1*(2), 83. https://doi.org/10.21067/mpej.v1i2.1967

Susilowati P. J., R. N. (2018). Hubungan Kemampuan Awal terhadap Kemampuan Berpikir Kritis

Matematika pada Siswa kelas VII SMP Pesantren Immim Putri Minasatene. *Mosharafa : Jurnal Pendidikan Matematika*, *7*(1), 199–206.

Sutrisna, N. (2021). Analisis Kemampuan Literasi Sains Peserta Didik SMA di Kota Sungai Penuh. *Jurnal Inovasi Penelitianitian*, *1*(12), 2683.

Syawaly, A. M., & Hayun, M. (2020). Pengaruh Penerapan Model Pembelajaran Problem Based Learning Terhadap Kemampuan Representasi Matematis Siswa Sekolah Dasar. *Instruksional*, *2*(1), 10. https://doi.org/10.24853/instruksional.2.1.10-16

Windyariani, S., & Amalia, R. A. (2019). *Science Literacy in Prospective Elementary School Teachers Through Science Technologu Literacy Learning*. *355*(Pfeic), 110–115. https://doi.org/10.2991/pfeic-19.2019.22

Yuliati, Y. (2017). Miskonsepsi Siswa pada Pembelajaran IPA serta Remediasinya. *Jurnal Bio Education*, *2*, 50–58.