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CAS Plan: Civitas Academic of School - Differentiated Learning to Optimize Science Learning Oriented to Increasing Scientific Literacy in Class VII-B of SMP IT Ar Raihan Bandar Lampung

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Abstract: This research aims to determine the effectiveness of using CAS-Plan to improve students' scientific literacy skills in science learning. This Classroom Action Research was carried out on students in class VII-B SMP IT Ar-Raihan Bandar Lampung which consisted of 24 students. Data on mastery of scientific literacy was collected using scientific literacy test instruments using test instruments that have been tested for validity, and reliability and have good distinguishing power. PTK is carried out in 2 cycles. In each cycle, there are two learning meetings. This research is declared successful if it meets all the specified criteria, namely (1) the student's scientific literacy test results increase from the previous cycle, (2) the student's mastery of scientific literacy skills is ≥ 75, class completion reaches ≥ 85% and the average score class ≥ 80. The results showed that 9 out of 24 students completed the scientific literacy of students before the action (pre-cycle) (37.5%), the class average was 58.0. After the action was taken, the results of the scientific literacy test showed that 22 students had completed it (91.6%), with a class average of 87.5. It can be concluded that the use of CAS-Plan in science learning has proven effective in increasing students. scientific literacy.

Keywords: CAS-Plan, scientific literacy, science learning

INTRODUCTION

In the 21st century, demands in the world of work require every individual to have various skills. The world of work requires individuals who are creative, innovative, critical, initiative, independent, able to lead, work together in teams, literate, communicate effectively, and able to make decisions and solve problems (Trilling & Fadel, 2009). 21st century skills are also socialized by the Ministry of Education and Culture of the Republic of Indonesia (Kemendikbud RI) in the term 4C 21st Century Skills, i.e.; (1) *creative thinking skill*, (2) *critical thinking and problem solving skill*, (3) *communication skill*, dan (4) *collaboration skill* (Kemendikbud, 2017).

(Liu, 2009) states that one of the many skills needed in the 21st century is scientific literacy. Scientific literacy is an individual's ability to apply scientific knowledge by interpreting information critically, using reasonable evidence, making decisions with scientific evidence, managing their uncertainty and negotiating ideas through claims in a conflict (Jufrida et al., 2019a; Kähler et al., 2020; Li & Guo, 2021; Scientific literacy is used to read, understand, and use scientific information to make intelligent decisions. Scientific literacy is becoming increasingly important because modern society is increasingly dependent on science and technology in its daily activities. However, in reality knowledge about science among the general public is still limited, and often incorrect scientific information is believed to be true facts (Wirzal et al., 2022).

Indonesia, as a developing country, has big challenges in increasing scientific literacy. Many international study results state the importance of developing scientific literacy through science education to face the challenges of social change in the 21st century. (Costa & Martins, 2011) stated that there is a lot of research on the importance of scientific literacy given in formal education which is linked to educational sustainability. This is necessary to overcome various social problems such as socio-economic disparities, health and illiteracy, therefore mastery of scientific literacy is absolutely necessary in facing the challenges of 21st century life.

In the current Indonesian education curriculum, the learning design of relevant science subjects always emphasizes students' ability to analyze, evaluate and create in accordance with the three highest levels of Bloom's taxonomy. Scientific literacy is not just a cognitive aspect, but includes all aspects, both cognitive, affective and psychomotor. This is in line with the opinion of (Bybee & McCrae, 2011) which states that scientific literacy is scientific knowledge and the use of this knowledge to recognize problems, discover new problems, describe natural phenomena scientifically, and provide explanations with scientific evidence, can make conclusions about problems related to science, understand how science and technology work, have an understanding of the ways knowledge and technology can influence the physical, intellectual and cultural environment, and understand how science and research interact with each other to create a science-literate society. Scientific literacy needs to be provided and trained to students to meet the

demands of 21st century curriculum skills and face real everyday life. Even though a lot of knowledge can be learned without being able to read (illiterate), or without being forced to read, they still have mental literacy, in the sense that they use literacy-oriented concepts in thinking and speaking (Ardila et al., 2010; Dinda et al., 2022).

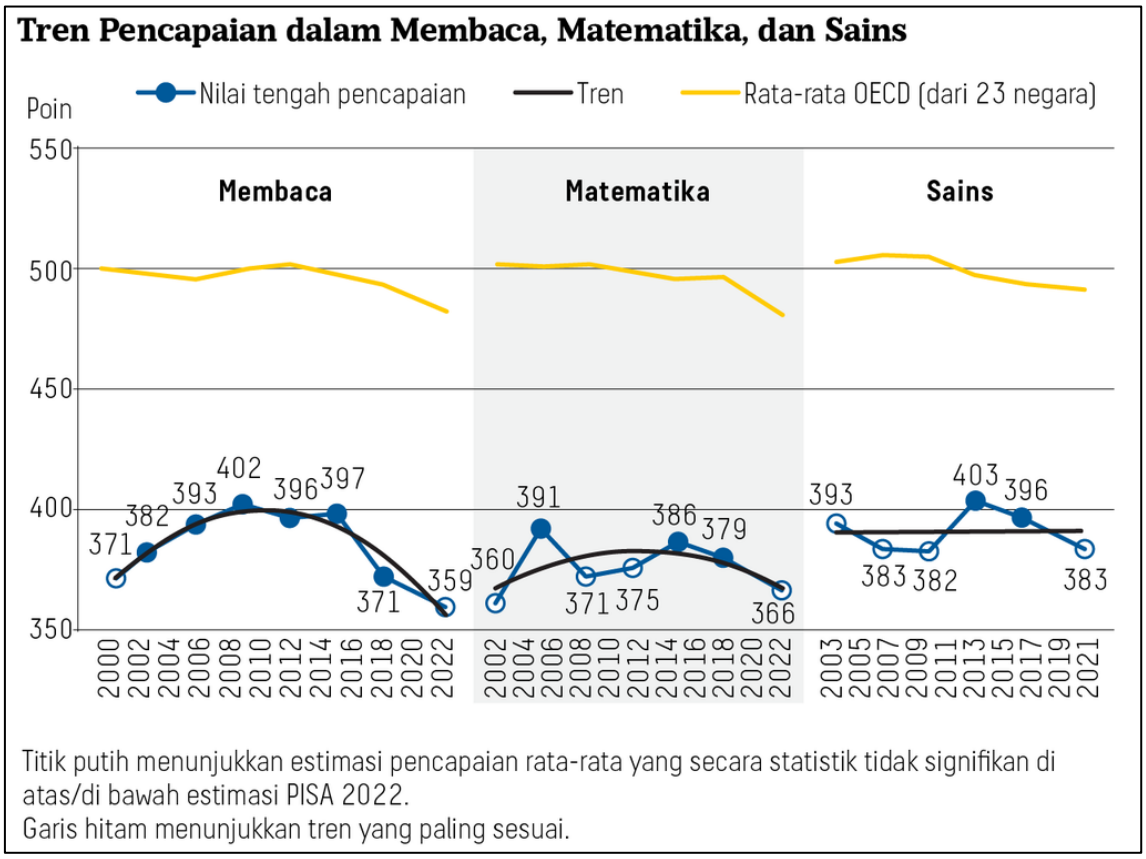

Figure 1. Trends in Indonesia's PISA Scores 2000-2022
(Source: OECD)

From the description above, it is clear that scientific literacy is very important for every individual to master it. However, the 2022 PISA results announced on December 5 2023 showed a decrease in Indonesia's PISA score compared to Indonesia's PISA score in 2018. Indonesia only scored 359 in reading, 366 in mathematics and 383 in science. This score has decreased when compared with Indonesia's PISA score in the two previous PISA tests in 2018 and 2015. This decrease in score was due to learning loss due to the Covid 19 pandemic which occurred in early 2020 to mid-2022. (OECD, 2023). The 2018 PISA results show that the ability of Indonesian students in reading achieved an average score of 371, still far below the international average of 487. Then for mathematics the average score reached 379 with an international average score of 487. Next for science, the average score of Indonesian students reached 389 with an international average score of 489 (Puspendik, 2019). Indonesia's PISA score in 2018 also experienced a decline compared to the PISA test results in

2015, where Indonesia's PISA score in 2015 in the Reading, Mathematics and Science aspects respectively achieved scores of 397, 386, 403 (Latip & Faisal, 2021) . The following is Figure 1 which shows the trend of Indonesia's PISA scores from 2000 to the latest PISA in 2022.

The decline and low number of Indonesia's PISA scores in the two latest PISA test results are very worrying. When compared with the international average score, Indonesia has quite a distance. Even Indonesia's PISA scores on the two most recent PISA tests failed to reach a score above 400 for the three aspects measured in PISA. In fact, if you look at the time from the start of taking the PISA test in 2006 to the latest PISA test in 2022, the PISA score for the scientific literacy aspect of Indonesian students was only once above 400, namely in 2015, the rest of the time, the scientific literacy score of Indonesian students was below 400 and certainly far from the average score. OECD international score is 500. This result is certainly sufficient to illustrate that the scientific literacy abilities of Indonesian students are still low (Merta et al., 2020; Suparya et al., 2022).

The results of other research on scientific literacy in Indonesia were conducted by the Ministry of Education and Culture in 2018. It was conducted using a survey method of students throughout Indonesia, with a total of 10,587 students from 34 provinces. The results of this research show that the scientific literacy of Indonesian students is still relatively low, with only 2.6% of students reaching a high level of scientific literacy, 42.8% of students at a medium level of scientific literacy, and 54.6% of students at a low scientific literacy level. These results show that many students in Indonesia have inadequate science skills and knowledge (Puspendik, 2019).

The emergence of problems in achieving scientific literacy is caused by a learning process that does not provide these abilities. Based on the conditions of science learning, it shows that educators (teachers) must create synergy between scientific literacy and science teaching, so that they can support student involvement in science learning and practice. Science teachers must be able to plan lessons that can help understand science content knowledge and scientific arguments (Relyea et al., 2022). (Jufrida et al., 2019) in their research stated that teacher factors, learning processes, learning environments, and school facility support also influence the development of students' scientific literacy abilities.

The most basic thing in mastering students' scientific literacy skills understands the basic concepts of science itself. A solid understanding of the scientific method, basic theories in various fields of science, and the scientific principles underlying knowledge is the basis for all aspects of scientific literacy. This helps students understand the world around them, explore scientific questions, and participate in science learning more effectively. Understanding basic concepts also helps students recognize and assess scientific information better, enabling them to become intelligent consumers in a society increasingly dominated by scientific knowledge (Willard, 2020).

Increasing scientific literacy skills through science learning that uses differentiated learning. Differentiated learning is a learning approach that allows teachers to meet the individual needs of each learner in the classroom. In practice, the teacher will present material and activities that are adapted to the level of understanding and learning style of each student (Fitra, 2022).

In implementing this differentiated learning process, there are three strategies that can be chosen, namely content differentiation, process differentiation and product differentiation. Content differentiation, namely what type of content or content the teacher will teach to students. Process differentiation, i.e. the process refers to how students will understand what they are learning. Product differentiation is the results of students' work after studying the material (Tomlison, 2001). Differentiated learning requires several supports so that learning can be optimal; one of these supports is the School Academic Community itself. This research examines efforts to increase students' scientific literacy through the use of the School Academic Community in Differentiated Learning (CAS-Plan).

METHOD

The method used in this research is the Kemmis-Mc Taggar Model of Classroom Action Research. The research location is at SMP IT Ar Raihan Bandarlampung. The action research population was students in class VII B of SMP IT Ar-Raihan Bandarlampung for the 2023/2024 academic year, totaling 24 students with material on Force and Newton's Laws. The research was carried out simultaneously with learning activities carried out in 2 cycles. In each cycle there are 4 stages of activity, namely (1) planning, (2) implementation (action), (3) observation (observation) and (4) reflection (Maulita, 2015). An overview of the PTK implementation scheme is illustrated as in Figure 2.

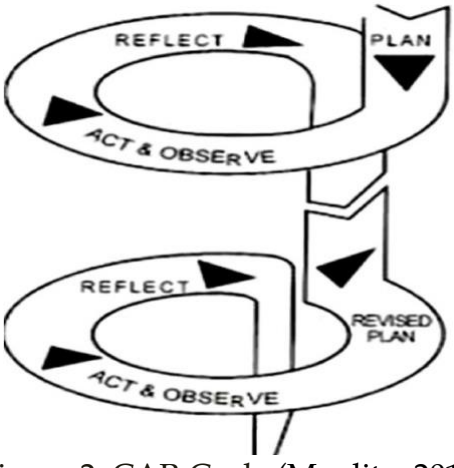

Figure 2. CAR Cycle (Maulita, 2015)

Data collection was carried out through (1) observation, this activity is to describe the learning process which is a source of data during action, (2) concept understanding tests with material assessment instruments Force and

Newton's Laws, and then (3) documentation, this data is used to support (triangulating) data from observations and tests that have been obtained previously. The teaching materials used in this PTK are the result of adaptations of teaching materials developed by (Maulita, 2015). These teaching materials are modified according to the need for adjustments in differentiated learning utilizing the academic community in the school environment (CAS-Plan). In learning activities, students are divided into groups based on the results of the initial diagnostic assessment. Each group will have unique teaching materials (designed according to students' learning styles. The concept mastery test instrument used is an instrument developed by (Astutik et al., 2022) which has been tested suitable for use based on the results of validity, reliability and differentiating power test.

RESULT AND DISCUSSION

Result of Research Procedure

Research activities will be carried out in August 2023 during the new normal. SMP IT Ar Raihan Bandarlampung is a school that has integrated the use of technology in learning activities, reducing the use of markers and paper in learning (paperless) by using touch screen-based learning devices such as SMART LCD projectors, iPads with the Apple ecosystem. The teaching materials developed by Maulita (2015) were initially designed in printed form, but with the digitization of learning carried out at the Ar Raihan school, the teaching materials are in electronic form.

In Cycle I activities took place in two meetings, the students' learning material was Style. Cycle II was carried out in two meetings which studied Newton's Laws. Learning activities were carried out by researchers with the help of fellow teachers as observers. The pretest to determine scientific literacy skills was carried out on Tuesday 1 August 2023 at the 5th and 6th hours of learning, with the provision of scientific literacy instruments. The first cycle of the 1st meeting was held on Tuesday 8 August 2023, the learning material was the Concept of Style. Learning uses electronic teaching materials in the form of modules complete with LKPD. Cycle I, the 2nd meeting, was held on Tuesday 15 August 2023 at the fifth and sixth hours, discussing the application of the concept of style in everyday life. At the end of the meeting of each cycle, a posttest is carried out.

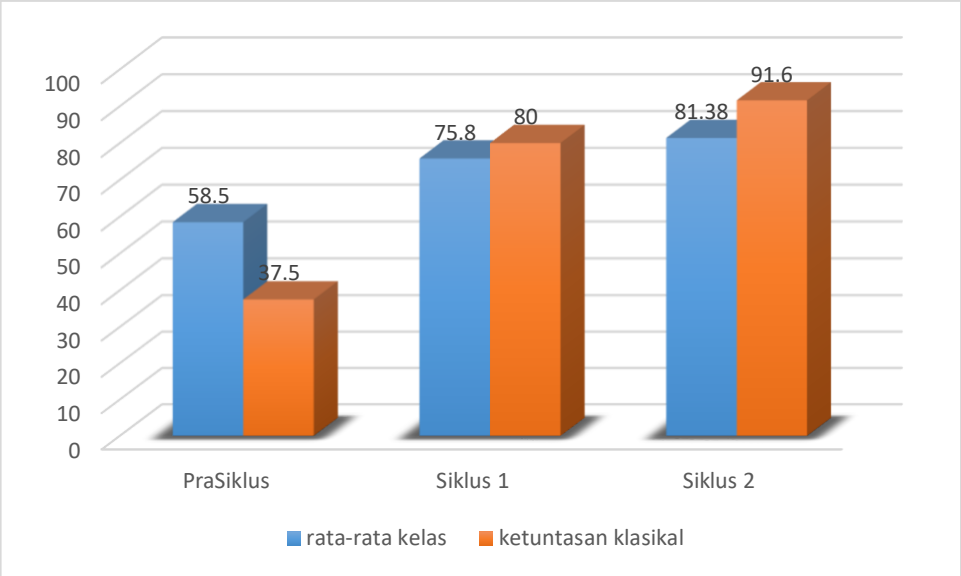

Figure 3. Action Results with Learning using CAS-Plan

The implementation of Cycle II, the 1st meeting, was held on Tuesday 22 August 2023 in the fifth and sixth hours of learning, the material was Newton's Laws. The second meeting of Cycle II learning activities was held on Tuesday 27th August 2023 with material on the application of Newton's Law. The results of the action in the form of achieving scientific literacy are illustrated in Figure 3. It showed that there is a significant increase in scientific literacy abilities from each PTK cycle that is passed. Increasing the scientific literacy skills of students who use differentiated learning can be caused by several factors (Mahabbati & Handoyo, 2023), including leraning adjusment, learning style, providing addtional support, increased engagement, and improved critical thinking skills.

Learning Adjustments: With a differentiated approach, teachers can adjust teaching methods, learning materials and assessments according to the needs and level of understanding of each student. This allows students to learn at a level appropriate to their abilities, so that they are more motivated and able to understand the subject matter better.1. Learning Adjustments: With a differentiated approach, teachers can adjust teaching methods, learning materials and assessments according to the needs and level of understanding of each student. This allows students to learn at a level appropriate to their abilities, so they are more motivated and able to understand the subject matter better.

Learning style considerations: Every student has a different learning style. With differentiated learning, teachers can accommodate various learning styles such as visual, auditory, or kinesthetic. This allows students to learn in the most effective way for them, so they more easily understand complex science concepts. Providing additional support: Students who need additional support in understanding science subject matter can be given extra help through differentiated learning. Teachers can provide individual guidance, additional

materials, or other resources according to student needs. This can help students who have difficulty overcoming obstacles in understanding scientific concepts.

Increased Engagement: By utilizing various learning approaches and resources, differentiated learning can increase student involvement in the learning process. Students become more active in learning participation because they feel more involved and challenged by the material presented. This can help increase students' interest in science and motivate them to study further. Improved Critical thinking skills: Differentiated learning often encourages students to engage in in-depth problem solving, discussion, and analysis. This can help improve students' critical thinking skills, which is an important aspect of scientific literacy. By engaging in deeper thinking about science concepts, students can develop a better understanding of how science works and how to apply it in real-world contexts.

Discussion

In differentiated learning, the School Academic Community (SAC), including teachers, students and other educational staff, has a very important role in differentiated learning. Teachers, as the main directors in the learning process, have in-depth knowledge of students' individual needs, interests and learning styles. By involving active teacher involvement, learning can be well adapted to the needs and levels of understanding of various students. Additionally, other educational staff members such as counselors, administrators, and tutors can also provide additional support needed to ensure students' success in learning. Through a collaborative approach involving the entire school academic community, an inclusive learning culture can be developed, creating an environment where every student feels supported and valued in their academic journey. Thus, actively involving the school academic community in differentiated learning is key to creating a learning environment that is centered on students' needs and ensuring their success in achieving their full potential (Afida, 2023). Figure 4 below is a portrait of learning activities that utilize the school academic community in the learning process.

Figure 4. Students are gathering information through interviews with security guards (source: personal document)

Learning that involves the School Academic Community in differentiated learning (CAS-Plan) which is oriented towards increasing students' scientific literacy has several significant advantages. First, personalization of Learning: By involving all members of the school academic community, teachers can better understand the individual needs of each student in acquiring scientific literacy. This allows for deeper learning adjustments according to each student's learning style, interests and level of understanding (Suntia, 2022). Second, special support: Education staff, including counselors, drivers, OB, CS, and security guards can provide additional support needed by students in developing their scientific literacy. This support may take the form of academic tutoring, addressing learning difficulties, or providing additional resources appropriate to individual needs.

The third advantage is collaboration between teachers and students, actively involving students in the differentiated learning process allows them to participate in determining the best way to learn. This collaboration creates an inclusive environment where students feel valued and have control over their learning, which can increase their motivation and engagement in science material (Syafii, 2023). Fourth, development of metacognitive skills: By involving students in the process of determining the best way to learn, they will also develop metacognitive skills that are important in understanding science concepts. Students learn to reflect on their own learning process, identify effective strategies, and adapt their approach according to needs (Nurwicaksono, 2017). Fifth, application of science concepts in real contexts: Differentiated learning involving the school academic community allows students to relate science concepts to real world contexts that are relevant to them. This helps strengthen their understanding of science and improves their ability to apply science knowledge in everyday life (Miqwati et al., 2023). By utilizing the potential and support of all members of the school academic community, differentiated learning oriented towards increasing students' scientific literacy can be more effective and provide a more meaningful learning experience for students.

CONCLUSION

Based on the results of research and discussion, the use of CAS-Plan in science learning oriented towards increasing scientific literacy has proven to be effective. This can be seen from the achievement of increasing students' scientific literacy at the end of the CAR cycle.

REFERENCES

Afida, R. N. (2023). Literature Review : Peran Guru dalam Membangun Ketrampilan 4C Siswa dengan Pembelajaran Berdiferensiasi. *Prosiding Seminar Nasional Pascasarjana Universitas Negeri Semarang*, 643–647.

Ardila, A., Bertolucci, P. H., Braga, L. W., Castro-Caldas, A., Judd, T., Kosmidis, M. H., Matute, E., Nitrini, R., Ostrosky-Solis, F., & Rosselli, M. (2010).

Illiteracy: The neuropsychology of cognition without reading. *Archives of Clinical Neuropsychology*, *25*(8), 689–712. https://doi.org/10.1093/arclin/acq079

Astutik, S. R. P., Siswanto, J., & Kaltsum, U. (2022). Pengembangan Asesmen Literasi Saintifik pada Pokok Bahasan Dinamika Hukum Newton. *Lontar Physics Today*, *1*(2), 66–74. https://doi.org/10.26877/lpt.v1i2.10282

Bybee, R., & McCrae, B. (2011). Scientific literacy and student attitudes: Perspectives from pisa 2006 science. *International Journal of Science Education*. https://doi.org/10.1080/09500693.2010.518644

Costa, C., & Martins, I. P. (2011). Education For Sustainable Development: Contributions To A Science Curriculum For Primary Education. In *INTED2011: 5th International Technology, Education And Development Conference*.

Dinda, D. A. S., Liliana, L., Susilawati, & Yovita. (2022). Profil Kemampuan Literasi Sains Siswa SMP Negeri 4 Tambang. *Bedelau: Journal of Education and Learning*, *3*(2), 62–72.

Fitra, D. K. (2022). Pembelajaran Berdiferensiasi dalam Perspektif Progresivisme pada Mata Pelajaran IPA. *Jurnal Filsafat Indonesia*, *5*(3), 250–258. https://doi.org/10.23887/jfi.v5i3.41249

Jufrida, J., Basuki, F. R., Kurniawan, W., Pangestu, M. D., & Fitaloka, O. (2019a). Scientific literacy and science learning achievement at junior high school. *International Journal of Evaluation and Research in Education*. https://doi.org/10.11591/ijere.v8i4.20312

Jufrida, J., Basuki, F. R., Kurniawan, W., Pangestu, M. D., & Fitaloka, O. (2019b). Scientific literacy and science learning achievement at junior high school. *International Journal of Evaluation and Research in Education*. https://doi.org/10.11591/ijere.v8i4.20312

Kähler, J., Hahn, I., & Köller, O. (2020). The development of early scientific literacy gaps in kindergarten children. *International Journal of Science Education*. https://doi.org/10.1080/09500693.2020.1808908

Kemendikbud. (2017). Panduan Implementasi Kecakapan Abad 21 Kurikulum 2013 Di Sekolah Menengah Atas. *Jakarta: Direktorat Pembinaan Sekolah Menengah Atas. Direktorat Jenderal Pendidikan Dasar Dan Menengah Kementerian Pendidikan Dan Kebudayaan*, i–45.

Latip, A., & Faisal, A. (2021). Upaya Peningkatan Literasi Sains Siswa melalui Media Pembelajaran IPA Berbasis Komputer. *Jurnal Pendidikan UNIGA*, *15*(1), 444. https://doi.org/10.52434/jp.v15i1.1179

Li, Y., & Guo, M. (2021). Scientific Literacy in Communicating Science and Socio-Scientific Issues: Prospects and Challenges. In *Frontiers in Psychology*. https://doi.org/10.3389/fpsyg.2021.758000

Liu, X. (2009). Science and the Public. International Journal of Environmental & Science Education. *International Journal of Environmental & Science Education*, *4*(3), 301–311.

Mahabbati, A., & Handoyo, R. R. (2023). *Diferensiasi pembelajaran*.

Maulita, I. (2015). *Pengembangan Bahan Ajar IPA Terpadu Berbasis Literasi Sains Bertema Aplikasi Gaya Dalam Kehidupan*.

Merta, I. W., Artayasa, I. P., Kusmiyati, K., Lestari, N., & Setiadi, D. (2020). Profil Literasi Sains dan Model Pembelajaran dapat Meningkatkan Kemampuan Literasi Sains. *Jurnal Pijar Mipa*, *15*(3), 223–228. https://doi.org/10.29303/jpm.v15i3.1889

Miqwati, M., Susilowati, E., & Moonik, J. (2023). Implementasi Pembelajaran Berdiferensiasi Untuk Meningkatkan Hasil Belajar Ilmu Pengetahuan Alam Di Sekolah Dasar. *Pena Anda: Jurnal Pendidikan Sekolah Dasar*, *1*(1), 30–38. https://doi.org/10.33830/penaanda.v1i1.4997

Nurwicaksono, B. D. (2017). PENERAPAN KOLABORASI STRATEGI METAKOGNITIF DALAM MENINGKATKAN HASIL BELAJAR SISWA PADA MATERI MENULIS KARYA ILMIAH. *Education and Human Development Journal*. https://doi.org/10.33086/ehdj.v2i2.396

OECD. (2023). Annex B1: Results for countries and economies. In *PISA 2022 Results (Volume I): Excellence and Equity in Education: Vol. I* (Issue Volume I).

Ploj Virtič, M. (2022). Teaching science & technology: components of scientific literacy and insight into the steps of research. *International Journal of Science Education*. https://doi.org/10.1080/09500693.2022.2105414

Puspendik. (2019). Pendidikan di Indonesia belajar dari hasil PISA 2018. In *Pusat Penilaian Pendidikan Balitbang KEMENDIKBUD* (Issue 021).

Relyea, J. E., Zhang, J., Wong, S. S., Samuelson, C., & Wui, M. G. L. (2022). Academic vocabulary instruction and socio-scientific issue discussion in urban sixth-grade science classrooms. *Journal of Educational Research*. https://doi.org/10.1080/00220671.2021.2022584

Suntia, D. (2022). Analisis Gaya Mengajar Guru Dalam Buku Strategi Belajar Mengajar Di Sekolah Dasar. *Novel Drug Targets with Traditional Herbal Medicines: Scientific and Clinical Evidence*, 95–108.

Suparya, I. K., I Wayan Suastra, & Putu Arnyana, I. B. (2022). Rendahnya Literasi Sains: Faktor Penyebab Dan Alternatif Solusinya. *Jurnal Ilmiah Pendidikan Citra Bakti*, *9*(1), 153–166. https://doi.org/10.38048/jipcb.v9i1.580

Suwono, H., Maulidia, L., Saefi, M., Kusairi, S., & Yuenyong, C. (2022). The Development and Validation of an Instrument of Prospective Science Teachers' Perceptions of Scientific Literacy. *Eurasia Journal of Mathematics, Science and Technology Education*. https://doi.org/10.29333/EJMSTE/11505

Syafii, I. (2023). Meningkatkan Keterampilan Kolaborasi Siswa melalui Model Pembelajaran berbasis Proyek: Materi Hakikat Ilmu Kimia dan Metode Ilmiah. *Jurnal Pendidikan Indonesia : Teori, Penelitian, Dan Inovasi*. https://doi.org/10.59818/jpi.v3i1.439

Tomlison, C. A. (2001). How To Differentiate Instruction in Mixed-Ability Classrooms. In *Association for Supervision and Curriculum Development* (Issue 2). https://doi.org/10.1016/0300-483X(87)90046-1

Trilling, B., & Fadel, C. (2009). *21st-Century Skills: Learning For Life In Our Times*. Jossey-Bass A Wiley Imprint.

Widodo, W., Sudibyo, E., Suryanti, Sari, D. A. P., Inzanah, & Setiawan, B. (2020). The effectiveness of gadget-based interactive multimedia in improving generation z's scientific literacy. *Jurnal Pendidikan IPA Indonesia*. https://doi.org/10.15294/jpii.v9i2.23208

Willard, T. (2020). The NSTA Atlas of the Three Dimensions. *NSTA Press*.

Wirzal, M. D. H., Nordin, N. A. H. M., Bustam, M. A., & Joselevich, M. (2022). Bibliometric Analysis of Research on Scientific Literacy between 2018 and 2022: Science Education Subject. *International Journal of Essential Competencies in Education*, *1*(2), 69–83. https://doi.org/10.36312/ijece.v1i2.1070