Indonesian Journal of Science and Education
Volume 07, Nomor 01, 2023, pp: 7~ 15
ISSN: 2598-5213e-ISSN: 2598-5205, DOI: 10.31002/ijose.v7i1.581
e-mail: ijose@untidar.ac.id, website: jurnal.untidar.ac.id/index.php/ijose

Implementation of Inquiry Learning Model with STEM Approach to Improve Student Science Literacy in Environmental Pollution Materials

Aulia Rahman
SMP Negeri 6 Lembah Gumanti
e-mail: rahmanaulia444@gmail.com

Received: March 15th , 2023 *Revised: Mach 25th , 2023* *Accepted: April 15th , 2023*

ABSTRACT

The study aims to improve the learning process that has been carried out with the aim of increasing students' scientific literacy on environmental pollution topic using the inquiry learning model with a Science, Technology, Engineering, and Math (STEM) approach. This research is Classroom Action Research (CAR). The subjects of this study were 34 students in class VII Semester 1 of 2022 at SMPN 6 Lembah Gumanti, Lembah Gumanti District, Solok Regency. This study consisted of 2 cycles with 4 stages, namely: planning, implementation, observation and reflection. Data collection techniques in this study are preliminary data, observations and written tests to measure scientific literacy skills in the form of knowledge (knowledge), competence (competences), and context (context) aspects collected using science literacy ability tests while attitude (attitudes) data is collected by using angket. Based on the results of the research carried out, the average score at cycle I was 67,06 and at cyclus II 85,88 so it can be concluded that the inquiry learning model with the STEM approach can improve student science literacy on environmental pollution materials.

Keywords : inquiry, STEM, scientific literacy

INTRODUCTION

The development of science and technology (IPTEK) in the current era of globalization requires humans to further improve their abilities and skills to be able to compete not only in the national but international scope (Hani, 2018). One of the basic sciences that has a very important role in supporting science and technology is science learning (Nofiana & Julianto, 2018). Science is knowledge about objects and natural phenomena obtained from the thoughts and research of scientists who are carried out with the skills of experimenting using the scientific method. The word science can also be translated as natural science which comes from the word natural science. In essence, science is the foundation for learning natural science (Tursinawati, 2016).

Natural Science is a science that studies natural phenomena in the form of facts, concepts and laws that have been verified through a series of research. This is in accordance with the opinion (Barus, 2022) that science is related to how to systematically find out about nature, so that it is not only mastering a collection of knowledge in the form of facts, concepts, or principles but also a process of discovery. Science learning has an important role in the world of education because it is the basis for the development of other sciences (Putra et al., 2016). Science learning is expected to help students to understand natural phenomena. Vennix et al., (2018) revealed that science learning in schools is taught in order to provide understanding to students so they can solve problems encountered in everyday life so as to facilitate their completion. Based on its characteristics, science learning can be

viewed from two sides, namely as a product of the work of scientists and the process by which scientists work to produce knowledge (Fitriyati et al., 2017). This proves that science is one of the subjects that is related to scientific literacy.

Scientific literacy can be defined as skills in the form of scientific concepts which contain systematic scientific methods to solve problems so that students can apply and maximize the knowledge and skills obtained at school into everyday life (Shahzadi & Nasreen, 2020). This is supported by another opinion expressed by Adiwiguna (2019) where scientific literacy is a scientific ability possessed by students in solving various kinds of problems and being able to explain scientific phenomena scientifically. Scientific literacy looks at the importance of the ability to think and act which includes mastering the ability to think and apply patterns of scientific thinking part of studying and responding to social issues (Pratiwi et al., 2019).

The ability of students' scientific literacy can be measured. To facilitate the assessment, scientific literacy is grouped into four interconnected domains. The 2015 PISA Framework (OECD, 2013) suggests four domains in scientific literacy, namely: 1) Context domain "The context domain covers areas of science application, including those regarding life and health, earth and environment, and technology. The PISA assessment covers general life which is broader and not limited to life in school only and students must be able to solve problems in everyday life"; 2) Knowledge domain "Knowledge domain consisting of content knowledge and procedural knowledge. In content knowledge, the content in the scientific literacy assessment is content in the fields of physics, chemistry, biology and earth which has relevance to real life situations, is an important scientific concept and is appropriate to the child's developmental level. While procedural knowledge is knowledge of scientific procedures used to obtain valid and reliable data"; 3) Competency domain "PISA 2015 suggests that students must have three competencies in order to have scientific literacy skills, these three competencies are interpreting scientific data and evidence, explaining scientific phenomena, evaluating and designing scientific investigations"; 4) Attitude domain "The 2015 PISA assessment will evaluate students' attitudes towards science in three areas, namely interest in science and technology, environmental awareness and assess scientific approaches to questions that are considered core to the construct of scientific literacy. Attitudes are considered important because if students have the three attitudes that have been mentioned, these students will be more responsible for managing their lives in the future.

In fact, Indonesia's scientific literacy level is still low compared to countries in the world, this is stated from the results of an assessment conducted by TIMSS (2015) and the PISA (Program for International Student Assessment) test evaluating Indonesia's literacy level at the 61st level out of 72 countries (OECD, 2016) and ranked 75th out of 80 countries (OECD, 2019). The low scientific behavior of Indonesian students in science material is due to various factors. According to Juwita, E, Sunyono, & Rosidin, U. (2022) the low level of scientific literacy of students is influenced by several factors, namely low interest in reading, evaluation tools that have not led to the development of scientific literacy, and the teacher's lack of knowledge about scientific literacy, selecting inappropriate learning models, the use of teaching materials that are not in accordance with the abilities to be measured. The same thing was stated by Rizkita (2016) the low ability of students' scientific literacy was due to the learning process not involving scientific processes. To be able to optimize students' scientific literacy abilities, accuracy is needed in choosing a learning approach.

The STEM (Science, Technology, Engineering, and Math) based learning approach is a learning approach that has a positive impact on the development of

scientific literacy. Because in general, STEM-based learning encourages students to design, develop, utilize, and apply science and technology. STEM is an acronym for science, technology, engineering, and mathematics. This term was first launched by the National Science Foundation (NSF) of the United States (US) in the 1990s as the theme of the education reform movement to grow the workforce in STEM fields, as well as develop citizens who are STEM literate (STEM literate), as well as increase US global competitiveness in science and technology innovation (Hanover Research, 2011).

The application of the STEM approach in integrated thematic learning processes is expected that students will acquire the various skills they need in the competitive environment of the 21st century (Falentina et al., 2018). The STEM approach also has advantages, namely: 1) Fostering an understanding of the relationship between principles, concepts, and expertise of a particular discipline, 2) Arousing student curiosity and activating creative imagination and critical thinking, 3) Helping students to understand and experiment with scientific process, 4) Encouraging collaborative problem solving and interdependence in group work, 5) Building active knowledge and memory through independent learning, 6) Developing the relationship between thinking, acting and learning, 7) Developing students' abilities to apply the knowledge they have learned (Sumaya et al. al, 2021).

The deficiencies in the application of the STEM learning model are as follows: 1) It takes a long time to solve problems, 2) Students who are weak in experiments and gathering information will experience difficulties, 3) There is a possibility that students are less active in group work, 4) If the topics of each group are different, students may not be able to understand the topic as a whole (Izzani, 2019). Learning with the STEM approach must be supported by an appropriate and appropriate learning model because it affects the learning process (Jiwanto, Sugianto, & Khumaedi, 2017), so that it can help achieve learning objectives (Ayuningtyas, Soegimin, & Supardi, 2015). Kong Suik Fern (2020) in his research said that the most suitable model to be paired with the STEM approach is inquiry..

The inquiry model is a learning model designed to provide experiences to students using the scientific method. The inquiry learning model comes from English, namely inquiry which can be interpreted as a process of asking and finding out answers to scientific questions posed. Inquiry has the goal of helping students develop discipline and develop the intellectual skills needed to ask questions and find answers based on curiosity.

The inquiry model is a series of learning that emphasizes the process of thinking critically and analytically to seek and find answers to a problem in question. According to Susanto (2016), the inquiry learning model emphasizes that educators apply learning activities that emphasize processes in understanding subject matter. Educators must also understand that the inquiry learning model is the essence of science learning. Inquiry-based science learning provides opportunities for students to continue to optimally develop their own potential, both cognitive, affective and psychomotor in discovering scientific concepts (Ramdani, 2020).

Sanjaya (2006) argues that inquiry learning strategies can make learning more meaningful, because in inquiry students find their own concepts, so that the knowledge gained lasts for a long time. This is supported by another opinion put forward by Mulyasa, (2007) who said that science education is directed to the process of inquiry and action so that it can help students gain a deeper understanding of the natural surroundings. The advantage of guided inquiry-based learning applied in this study lies in the involvement of students in learning. Students study independently in small groups, conduct experiments, explore knowledge, practice science process skills, and construct conclusions. The teacher acts as a facilitator

who directs the processes that occur in groups. This is in accordance with Bruner's opinion, (in Trianto 2014) which states that trying alone to find solutions to problems produces knowledge that is truly meaningful..

Based on the explanation above, the researcher is interested in conducting research on the application of the inquiry learning model with the STEM approach to increase students' scientific literacy on the theme is environmental pollution. The theme of environmental pollution is studied in class VII, the researcher chose this theme with the assumption that the characteristics of this material are suitable for the application of the inquiry model. On this basis, researchers are interested in conducting research with the title "Application of the inquiry learning model with the STEM approach to increase students' scientific literacy". This study aims to improve students' scientific literacy by applying the inquiry learning model with the STEM approach at SMP Negeri 6 Lembah Gumanti TP. 2022/2023.

METHODE

The research was conducted at SMPN 6 Lembah Gumanti, Solok Regency in Class VII for the 2022/2023 school year. Making actions based on reflections that have been done. This research was carried out in an odd semester, the 2022/2023 school year, in which the implementation of the actions was carried out from 10 October to 17 October 2022 with 2 meetings. The research subjects were class VII students of SMPN 6 Lembah Gumanti with a total of 34 students, consisting of 14 boys and 20 girls.

This research was conducted using classroom action research methods which were divided into two cycles. The plot refers to the Kemmis and Mc Taggart model in Waitlem and Risman (2016) which consists of planning, action, observation and reflection activities. The implementation of the action was carried out in two cycles. Each cycle consists of four phases as follows: (1) Action planning, (2) Action implementation, (3) Observation, and (4) Analysis and Reflection.

Research instruments are tools or facilities used by researchers in collecting data (Arikunto, 2005). Instruments in this study were used to measure indicators of scientific literacy in Knowledge Aspects, Competency Aspects, Context Aspects, and Attitudes Aspects. The data collection technique in this study was a written test expressed in the form of multiple choice questions and observation through a questionnaire.

Data analysis to determine the absorption capacity of each student used a formula, namely the scores obtained by students divided by the maximum score multiplied by one hundred percent.

Observation is a data collection technique by observing every ongoing event and recording it with an observation tool about the things to be studied. Observations in this study are intended to assess students' interest and performance during the learning process. To process data on aspects of science attitudes using a Likert scale.

The problem-solving plan and the actions to be taken in this study are to use the Inquiry Learning model with the STEM approach. This model aims for students to directly get full experience of the concepts of physics that occur so that they can increase students' scientific literacy and can apply them in everyday life. The learning outcomes to be achieved in this study are that students can identify interactions between living things and their environment, and can design efforts to prevent and overcome pollution and climate change.

RESULT AND DISCUSSION

Classroom Action Research conducted to see an increase in student learning outcomes and scientific literacy using an inquiry learning model with a STEM approach to environmental pollution material. The steps taken in this study followed the CAR procedure. This research

was conducted in 2 cycles consisting of four stages, namely: planning, action, observation, and reflection. Explanation of each stage in cycle 1 can be seen from the following description.

Action Planning

Planning is an action that will be carried out with the provisions and criteria set by the researcher in solving the problem so that what will be achieved is in accordance with the research objectives. The activities carried out in this planning are preparing a learning implementation plan using an inquiry learning model with a STEM approach on the theme of environmental pollution, preparing an observation format for the learning process (teacher observation and student observation), and preparing grids and science knowledge test questions.

Action Implementation

The implementation of learning activities with inquiry learning with the STEM approach is carried out in 2 meetings with an allotted time of 2 x 40 minutes, while the evaluation is carried out at the end of the meeting. Then learning activities are carried out through 5 phases. The following is a description of the stages of the activity: The process of implementing the first meeting action begins with preliminary activities, namely, the teacher enters the class and says hello, the teacher checks attendance, conducts apperception by asking questions related to the concepts to be studied and then explaining the basic competencies and learning objectives to be achieved. Phase 1 core activity (Student Orientation on the problem). Phase 2 defines the problem. Phase 3 (Developing hypotheses). Phase 4 (gathering information) in this activity the teacher asks students in groups to carry out investigations to prove the hypotheses they make. Phase 5 (Analyze and evaluate the description of the problem solving process). Closing activity where after the whole group has made a group presentation, then the teacher gives a written test in the form of multiple choice questions to measure aspects of knowledge and science processes/competencies in the context of science (to students. The partner teacher greets, as a sign that learning has been end.

Observation

During the learning process, researchers and teacher observers (collaborators) observed the progress of learning during cycle one. Observations were made by recording events/events that were experienced at each meeting or face-to-face meeting. Observations were made, namely monitoring learning activities or student motivation during the teaching and learning process taking place for each cycle, as well as observing students' attitudes and behavior during the teaching and learning process.

Observations were carried out thoroughly, starting from preliminary actions, core activities, to closing activities. A series of processes of implementing the action were observed both observing the behavior/learning activities of students during the learning process, using observation sheets. The average percentage of achievement of science attitudes in the implementation of the inquiry learning model with the STEM approach was obtained, namely in cycle I was 81.99% while in cycle II it was 88.97%. Thus there is an increase of 7%. The results of the implementation of learning can also be seen in Figure 1.

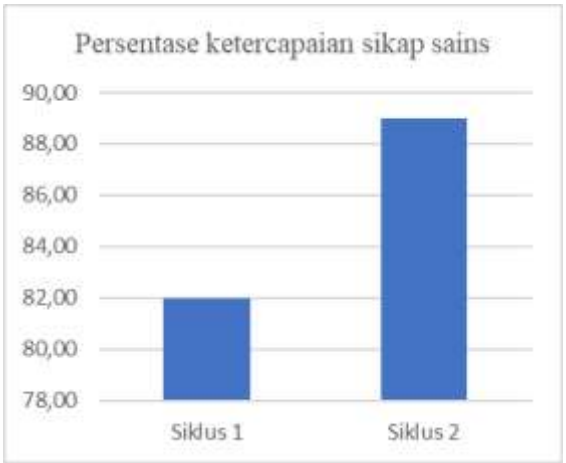

Figure 1. Percentage of achievement of science attitude

While the average observation of the implementation of inquiry learning in cycle I and cycle II when observations were carried out, data was obtained as shown in Figure 2

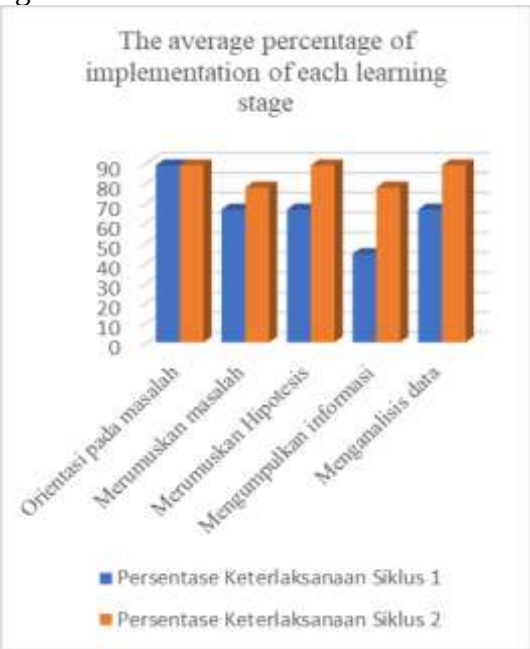

Figure 2. The average percentage of the implementation of each stage of learning the inquiry model with the STEM approach

Based on Figure 2, the implementation of learning using the inquiry model with the STEM approach for cycle I was 66.68%, meanwhile, the average implementation of learning using the inquiry model with the STEM approach for cycle II was 84.46. The increase in the percentage of learning implementation at each stage of inquiry learning indicates that students and teachers are getting used to the stages of inquiry learning. The results of this implementation are also directly proportional to the increase in student learning outcomes after getting learning using the inquiry model with the STEM approach.

Improved Learning Outcomes

Student scientific literacy tests are divided into two categories based on the instruments given to students. Multiple choice tests (multiple choice) to measure aspects of knowledge and science processes/competencies in the context of science.

Based on the results of the knowledge test using multiple choice questions on the theme of environmental pollution, it can be obtained data on the results of students' scientific literacy abilities during learning in cycle I and cycle II by using the inquiry model learning with the STEM approach, as shown in the figure 3.

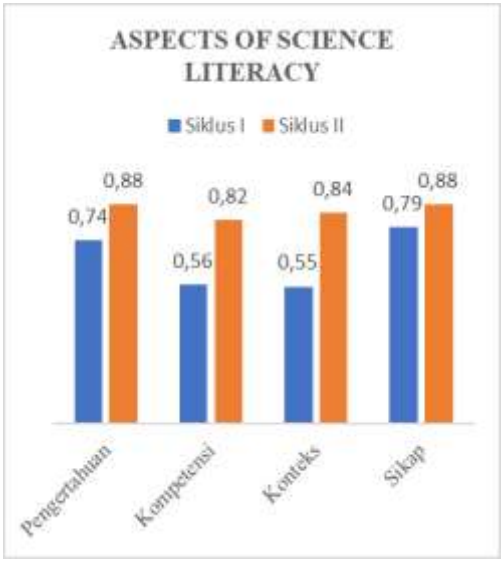

Figure 3. The results of improving the ability of students' scientific literacy aspects

Based on Figure 3, it can be seen that the results of improving students' scientific literacy skills in the knowledge aspect have increased where in the first cycle the average knowledge aspect was 0.74 and experienced an increase in the second cycle, which was 0.88. Then in the competency aspect there was also an increase where cycle I got an average result of 0.56 which increased to 0.82. In the context aspect, the average achievement of scientific literacy skills in cycle I was 0.55 and experienced an increase in cycle II, namely 0.84. While the attitude aspect also experienced an increase from 0.79 in cycle I to 0.88 in cycle II.

After processing the data on each aspect of literacy, data on student learning outcomes is obtained by using the inquiry learning model with the STEM approach, as shown in Figure 4.

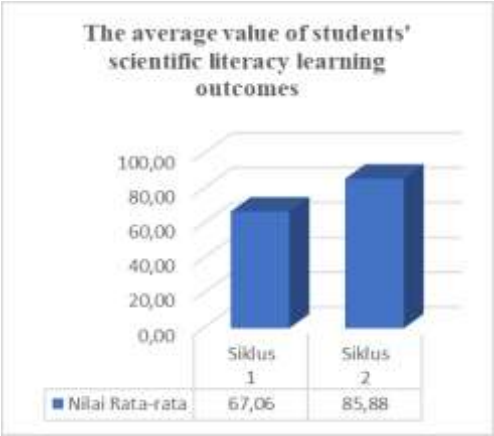

Figure 4. The average value of scientific literacy learning outcomes

Based on Figure 4, it can be seen that the test scores on knowledge skills and science processes in cycle I show that the lowest score is 56 while the highest score is 72. Meanwhile in cycle II it can be seen that the lowest score is 80 and the highest score is 92. Then the average student score is 67.06 Of the 34 students who took part in the evaluation there were 17 students who completed their studies, so that the learning completeness in cycle I was 50%. In cycle II the average value of students was 85.88 and the percentage of student completeness in cycle II was 100%. Thus this value indicates that it has met the learning completeness requirements set by the curriculum, namely 70%. Data on improving student learning outcomes using the inquiry learning model with the STEM approach.

These results are consistent with the definition of the inquiry model as student activity in developing knowledge and understanding with scientific ideas, just as scientists study the real world (NES, 1996). In addition, inquiry also means a series of learning activities that maximally involve all students' abilities to search and investigate systematically, critically, logically, analytically, so that they can formulate their own findings with confidence (Gulo in Trianto, 2009). Daryanto (2013) states that a learning approach that is able to actively involve students in direct learning will be more effective than an approach that only provides instant information knowledge. This is in line with the results of research conducted by (Rosana, 2022) stating that the inquiry learning model with the STEM approach has an effect on increasing students' scientific literacy skills. Based on the data obtained, the increase in scientific literacy skills in the experimental class is in a category that is superior to the control class which is in the low category.

Reflection

In the reflection activity, the teacher carries out discussion activities with collaborators. What is discussed in the reflection activity is the extent to which the learning process can overcome student learning difficulties. This can be known from the results of observations.

Based on the analysis of cycle 1 and cycle 2 in the process of implementing the inquiry model learning model with the STEM approach where the results obtained in cycle 1 were lower than cycle 2 because in cycle 1 learning was divided into 5 groups where in four groups there were seven people. In cycle 2 the teacher changed the strategy so that learning outcomes in cycle 2 increased the teacher divided students into 8 groups where in each group there were four and 5 students. By dividing students into 8 groups so as to make students active in practicum activities, discussions and presenting the results of discussion activities.

Then another factor that resulted in the learning process of the inquiry model with a low STEM approach in cycle I was because students were not used to doing practicum activities so that students had difficulty getting data and drawing conclusions from the data they had to get. In cycle 2 students are accompanied to collect data and make conclusions from the data they get. With this assistance, there is an increase in student literacy in learning using inquiry learning models with the STEM approach.

CONCLUSION

Based on the results of the classroom action research analysis, it can be concluded as follows: that learning the inquiry model using the STEM approach can improve scientific literacy and student learning outcomes at SMPN 6 Lembah Gumanti in class VII semester 1 of the 2022/2023 school year, this can be seen from the average score the average obtained in cycle I was 67.06 to 85.88 in cycle II. Then the suggestions that the researcher can propose are 1) Science learning should not only aim to understand one concept but should be able to train students' scientific literacy; 2) In carrying out inquiry model learning it is hoped that more attention will be paid to the group determination system when carrying out learning activities, because group determination can sometimes hinder a learning process; 3) There is a need for further researchers regarding the use of inquiry models with the STEM approach to increase students' scientific literacy in different materials.

ACKNOWLEDGEMENT

Thank you to the SMP Negeri 6 Lembah Gumanti, class VII students, all teaching partners and all parties for the good cooperation.

REFERENCE

Adiwiguna, P.S., Dantes, N., & Gunamantha, I. M. (2019). Pengaruh Model Problem Based Learning (PBL) Berorientasi STEM Terhadap Kemampuan Berpikir Kritis Dan Literasi Sains Siswa Kelas V SD Di Gugus I Gusti Ketut Pudja. Jurnal Pendidikan Dasar Indonesia, 3 (2), 94-103.

Arikunto, S. (2005). *Menajemen Penelitian,* Jakarta: Rineka Cipta.

Ayuningtyas, P., Soegimin, W. W., & Supardi, I. A. (2015). Pengambangan perangkat pembelajaran fisika dengan model inkuiri terbimbing untuk melatihkan keterampilan proses sains siswa sma pada materi fluida statis. Jurnal Penelitian Pendidikan Sains UNESA, 4(2), 636–647.

Barus, M. (2022). Literasi sains dan pembelajaran IPA di Sekolah Dasar. Jurnal Pendidikan Bahasa Indonesia dan Sastra. 5 (1). Hal 17-23.

Daryanto. 2013. Inovasi Pembelajaran Efektif. Bandung: Yrama Widya.

Falentina, C. T., Abdul, D., Lidinillah, M., & Mulyana, E. H. (2018). Pedadidaktika : Jurnal Ilmiah Pendidikan Guru Sekolah Dasar Mobil Bertenaga Angin: Media Berbasis STEM untuk Siswa Kelas IV Sekolah Dasar. 5(3), 152–162

Hani, R. & Suwarma, I.R. 2018. Profil motivasi belajar IPA siswa sekolah menengah pertama dalam pembelajaran IPA berbasis STEM. Jurnal Wahana Pendidikan Fisika, 3(1):63-73.

Hanover Research (2011). K-12 STEM education overview.

Izzani, L. M. (2019). Pengaruh Model Pembelajaran STEM Terhadap Hasil Belajar Siswa Pada Materi Asam Basa di SMA Negeri 1 Baitussalam Aceh Besar. Fakultas Tarbiyah dan Keguruan Universitas Islam Negeri Ar-Raniry.

Jiwanto, I. N., Sugianto, S., & Khumaedi, K. (2017). Pengaruh implementasi model pembelajaran inkuiri terbimbing kooperatif jigsaw terhadap keterampilan proses sains siswa. Jurnal Pendidikan IPA Vetran, 1(1), 1–7.

Juwita, E., Sunyono, Rosidin, U. (2022). Analisis Kemampuan Literasi Sains Siswa Kelas IX MTs Negeri 1 Lampung Barat Pada Materi Bioteknologi Berbasis Etnosains. Jurnal Edukasi Matematika dan Sains, 10 (2), 232-242.

Kong S. F, Mohd. E. (2020). Pendekatan STEM dalam proses pengajaran dan pembelajaran: Sorotan Literatur Bersistimatik. Jurnal Pendidikan Sains dan Matematik Malaysia, 2 (2), 29-44.

Mulyasa, E. (2007). *Kurikulum Tingkat Satuan Pendidikan Sebuah Panduan Praktis*. Bandung: PT Remaja Rosdakarya

Nofiana, M. & Julianto, T. 2018. Upaya peningkatan literasi sains siswa melalui pembelajaran berbasis keunggulan local. Bioser: Jurnal Tadris Pendidikan Biologi, 9(1), 24-35.

NRC (National Research Council), (1999). *Inquiry and The National Science Education Standar: Guide for Teaching and learning.* Washington: national Academic Press

OECD. (2013b). *PISA 2015 Draft Science Framework.*

OECD. (2016). *PISA 2015 Result In Focus (Paris OECD).*

OECD. 2016. *PISA 2015 Assessment and Analytical Framework Science, Reading, Mathematic and Financial Literacy. Paris: OECD Publishing*.

OECD. (2019). *PISA 2018 Results What Students Know And Can Do Volume I. Paris: OECD Publishing*.

Pratiwi, S. N., Cari, C., & Aminah, N. S. (2019). Pembelajaran IPA Abad 21 dengan Literasi Sains Siswa. Jurnal Materi Dan Pembelajaran Fisika, 9, 34–42.

Putra, R. W. Y., & Anggraini, R. 2016. Pengembangan Bahan Ajar Materi Trigonometri Berbantuan Software iMindMap pada Siswa SMA. Jurnal Pendidikan Matematika, 7(1), 39–47.

Ramdani, A., A, Wahab Jufri, Jamaludin, & Dadi Setiadi(2020). Kemampuan Literasi Sains Peserta Didik SMPN di Kabupaten Lombok Tengah. Program Studi Pendidikan Biologi, FKIP Universitas Mataram. 5(2), 2020.

Rosana, A., A. (2022). Pengaruh Model Pembelajaran Inquiry dengan Pendekatan STEM terhadap Kemampuan Literasi Sains Siswa, diakses pada tanggal 27 April 2023, http://repository.upi.edu/78145/.

Sanjaya, W. (2006). Pembelajaran dalam implementasi kurikulum berbasis kompetensi. Jakarta: Kencana Prenada Media Group.

Shahzadi, I., & Nasreen, A. (2020). Assessing Scientific Literacy Levels among Secondary School Science Students of District Lahore. Bulletin of Education and Research, 42(3), 1–21.

Sumaya, A., Israwaty, I., Ilmi, N. (2021). Penerapan pendekatan STEM untuk meningkatkan hasil belajar siswa sekolah Dasar di Kabupaten Pinrang. Jurnal Of Education, 1(2), 217-223.

Susanto, A. (2016). Teori Belajar dan Pembelajaran di Sekolah Dasar.Jakarta: Prenadamedia Group.

Trianto (2007). *Model-model Pembelajaran Inovatif berorientasi Kontruksivisme.* Jakarta: Prestasi Pustaka.

Trianto. (2014). *Model pembelajaran Terpadu: Konsep, Strategi, dan Implementasinya dalam KTSP*. Jakarta: PT. Bumi Akasara.

Tursinawati. (2016). Penguasaan konsep hakikat sains dalam pelaksanaan percobaan pada pembelajaran IPA di SDN Kota Banda Aceh. Jurnal Pesona Dasar, 2(4):72-84.

Vennix, J., den Brok, P., & Taconis, R. (2018). Do outreach activities in secondary STEM education motivate students and improve their attitudes towards STEM?. *International Journal of Science Education*, 40 (11), 1263–1283.

Waitlem dan Risman. (2016). *Praktik Praktis Penulisan Karya Tulis Ilmiah untuk Guru*. Padang: KABARITA.