IMPROVING STUDENTS' SCIENTIFIC LITERACY THROUGH PROBLEM BASED LEARNING

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ABSTRACT:
Scientific literacy ability is one of the competencies that students must have in this era of globalization. The purpose of this study was to determine the increase in students' scientific literacy skills through the application of problem based learning. This research was conducted using classroom action research methods in the Engineering Physics course. Each indicator of scientific literacy has increased from cycle I to cycle II. The scientific literacy context indicator increased from 67.86% to 82.14%, the knowledge indicator increased from 60.71% to 85.71%. Competency indicators also progressed from 53.57% to 78.57%, while attitude indicators experienced a fairly high increase from 42.86% to 75%. This indicates that students' scientific literacy skills can be improved through problem based learning. Therefore, this problem-based learning model needs to be applied at the tertiary level to be able to hone and develop scientific literacy skills that exist in students.

Keywords: scientific literacy, problem based learning, Engineering Physics.
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INTRODUCTION

The rapid development of science and technology encourages people to be able to prepare themselves from an early age with various competencies. Literacy ability is one that students have and is fostered starting from basic education. One of the literacy skills that has received a lot of attention in the academic field is scientific literacy.

Scientific literacy according to the OECD in (Kemdikbud, 2017) is the ability to identify questions, acquire new knowledge, explain scientific phenomena, and draw conclusions based on facts, understand the characteristics of science, awareness of how science and technology shape the natural, intellectual and cultural environment, as well as the ability to be involved in and concerned about science-related issues. According to PISA scientific literacy is characterized by four interrelated aspects, namely: 1) context, recognizing life situations that involve science; 2) knowledge, understanding nature based on scientific knowledge; 3) competency, demonstrating scientific ability which includes identifying problems, explaining phenomena scientifically, and drawing conclusions based on evidence; 4) attitude, showing interest in science, participating in scientific investigations, and motivation to act responsibly towards natural resources and the environment (OECD, 2017).

Scientific literacy is very beneficial for every individual and society in general. With scientific literacy skills one can understand phenomena that occur in nature, especially in the surrounding environment and analyze them based on their knowledge and facts. It is undeniable that current technological advances have an impact that can affect various fields. Not infrequently these technological advances bring problems both in the natural, social, and economic environment. Individuals who have scientific

literacy skills will be able to solve problems in their surroundings with their scientific concepts (Bagasta et al, 2018).

The level of scientific literacy ability of students in the world is analyzed through the PISA (Program for International Student Assessment) assessment which is conducted every 3 years. In 2009 the literacy skills of students in Indonesia obtained a score of 383 in rank 57 of the 65 countries studied, while in 2012 Indonesia was ranked 64 out of 65 countries which were the subject of research with a score of 382 (Astuti, 2017). Then in 2015 Indonesia's PISA score increased to 403 points, ranking 62 out of 72 countries participating in the survey (Tohir, 2016). Furthermore, in 2018 Indonesia was ranked 70 out of 78 participating countries with mean score of 371 (OECD, 2019) From the three PISA scores it can be seen that the scientific literacy skills of Indonesian students are still below the average and in need of major repairs. Various studies to determine scientific literacy skills have been carried out including (Yuliati, 2017) which examined scientific literacy in science learning, (Nofiana, 2017) which described the low scientific literacy abilities of junior high school students, (Rini et al, 2021) which analyzed students' literacy abilities and there are also those who conduct literature studies on efforts to increase scientific literacy (Utami, 2018).

Education is a conscious and planned effort to create a learning atmosphere and learning process so that students actively develop their potential to have religious spiritual strength, self-control, personality, intelligence, noble character, and the skills needed by themselves, society, nation and state (Undang-Undang Republik Indonesia Nomor 20 Tahun 2003 Tentang Sistem Pendidikan Nasional, 2004). The Ministry of National Education in (El Islami, 2015) conducted a study on the Science Curriculum and concluded that learning Science should be able to foster students' confidence that they are capable of learning Science and Science is not a lesson to be feared; science learning does not only discuss theory, but also the development of scientific attitudes and skills; science learning provides a learning experience that develops the ability to analyze, organize, carry out scientific investigations, use the knowledge possessed to understand natural phenomena that occur around them.

Scientific literacy skills must be instilled in students through learning as a provision for the future. The learning process must be creatively designed to be able to train students' scientific literacy skills. There are several factors that influence the scientific literacy abilities of Indonesian students, including the use of learning models and teaching materials (Kurnia, 2014). In addition, (Fazilla, 2016) argues that scientific literacy is influenced by the arrangement of the scope of the material, the selection of learning media, and the use of learning models. Selection and use of approaches, methods, models, strategies and assessments are needed in improving the quality of learning in schools

Several studies on increasing scientific literacy skills through the application of learning models have been carried out including using contextual learning (Srikandi et al, 2017), project-based learning (Sari et al, 2017), scientific learning (Asyhari & Hartati, 2015). There are also those who use a problem-based learning model (Betari et al, 2016; Astuti et al, 2017).

PBL is a student-centered learning-oriented learning model that is capable of cultivating a creative, collaborative spirit, metacognitive thinking, developing higher-order thinking skills, increasing independence, facilitating problem solving and building teamwork (Sofyan & Komariah, 2016). Problem based learning (PBL) raises a problem as the first step in the learning process (Astuti et al, 2017). Students are given problems related to everyday life, while the teacher plays a role in guiding students to think critically and actively in their groups to identify problems, make hypotheses, seek information, conduct experiments and determine the best solutions to these problems (Hartati, 2016). The problem based learning (PBL) syntax described by (Arends, 2012) includes: 1) directing students to problems, 2) organizing students for learning, 3) assisting independent and group investigations, 4) developing and

presenting work, and 5) analyze and evaluate the problem-solving process. The results of the study (Utami, 2014) suggest that learning using the problem-based learning model can affect increased scientific literacy in science learning.

In this study the problem based learning (PBL) model was chosen as a solution to improve student literacy skills because of the interrelationships between each variable. The initial stages in PBL through giving problems have fostered students' scientific literacy abilities. Through these problems each student will relate problems to each other with the knowledge they have, try to find facts and work in groups. Investigations carried out independently or in groups produce a conclusion as a problem solving. The presentation of the results of the investigation becomes an evaluation material for the scientific process that has been carried out. The purpose of this research was to find out the increase in students' scientific literacy skills in Engineering Physics courses.

METHOD

The method used to collect data on improving students' scientific literacy abilities in research is the classroom action research method. The implementation of this classroom action research was carried out in 2 cycles. Each cycle has 4 activities, namely planning, acting, observing, and reflecting (Juanda, 2016). Cycle 1 was carried out in 2 meetings. Observation and reflection activities in cycle 1 became the basis for determining the implementation of cycle 2 with a minimum percentage of students' scientific literacy ability of 70% for each indicator. The sample in this study were 28 students in the first semester of the Computer Science Study Program, Faculty of Engineering, Graha Nusantara University Padangsidimpuan.

The data collection technique used in this study is a test technique. The instruments used were student worksheets (LKM) and scientific literacy ability test sheets according to scientific literacy ability indicators. The scientific literacy ability indicators used refer to aspects of the PISA scientific literacy assessment (OECD, 2017), namely context, knowledge, competencies, and attitudes.

RESULTS AND DISCUSSION

Improving students' scientific literacy abilities in this study was carried out by applying problem based learning to the teaching of Engineering Physics. This research was conducted in 2 cycles. The first cycle was applied to the quantity and measurement material, while the second cycle material was Kinematics. The percentage of students' scientific literacy abilities in cycle I can be seen in the following table

Table 1. Scientific Literacy Ability of Students in Cycle I

Indicator	Percentage
Context	67,86%
Knowledge	60,71%
Competencies	53,57%
Attitudes	42,86%

The results of observations in cycle I showed that students' scientific literacy skills had not reached the targeted percentage of 70%. Therefore, reflection and improvement was carried out in the second cycle. The percentage of students' scientific literacy abilities in cycle II can be seen in the following table

Table 2. Scientific Literacy Ability of Students in Cycle II

Indicator	Percentage
Context	82,14%
Knowledge	85,71%
Competencies	78,57%
Attitudes	75,00%

The results of observations in cycle I and cycle II show that students' scientific literacy skills have increased by applying problem based learning (PBL). The increase in scientific literacy can be seen in the following graph.

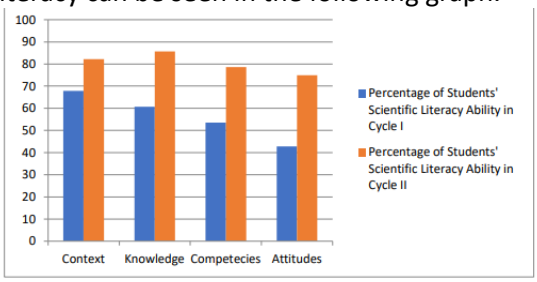

Figure 1. Increasing Students' Science Literacy Ability in Cycles I and II

The results of observations in this classroom action research showed that there was an increase in students' scientific literacy skills using the problem based learning (PBL) model. The ability of students' scientific literacy in each indicator in cycle II increased from cycle I.

The context of scientific literacy includes areas of science application which include personal, local and global issues. In cycle I it can be seen that students' scientific literacy abilities on context indicators are still lacking, namely with a percentage of 67.86% of the total number of students who answered questions correctly related to the context of scientific literacy, meaning that students' introduction to the surrounding life situation related to quantity and measurement is still lacking. In cycle II, the context indicator increased to 82.14%. This shows that the introduction of students about the surrounding natural phenomena related to kinematics is getting better.

Scientific literacy knowledge describes students' understanding of facts, theories and concepts that build the foundation of scientific knowledge. The indicator of scientific literacy knowledge in cycle I was still relatively low, namely with a percentage of 60.71% of students who answered correctly. This situation indicates that students are still unable to associate phenomena that occur in their surroundings with the basic knowledge they have acquired. In cycle II the scientific literacy knowledge indicator increased to 85.71% who answered correctly. This shows that students are increasingly able to analyze events in the natural surroundings and how these events can occur with the scientific concepts and theories they have.

Scientific literacy competency indicators refer to students' ability to identify and explain scientific phenomena based on scientific knowledge, and use existing evidence to draw conclusions. In cycle II 53.57% of students answered correctly on the competency indicator, meaning that students' scientific abilities were still very low in investigating and evaluating phenomena that occurred in the natural surroundings. Competency indicators in cycle II increased with a percentage of 78.57%. This figure shows that students' abilities are getting better at explaining surrounding natural phenomena, designing and conducting investigations, drawing conclusions, and determining appropriate solutions.

Attitude indicators in cycle I are shown with a very low percentage of 42.86%. After the implementation of this first cycle, it turns out that the attitude of students towards phenomena that occur in the universe is still very lacking. In cycle II this indicator increased drastically with a percentage of 75%. After the implementation of cycle II, students' concern for the natural surroundings increased, interest in science and technology also increased. Interest in scientific phenomena encourages students to try to solve problems related to science (Nisa Wulandari, 2015).

Scientific literacy ability according to PISA (OECD, 2017) is the ability to use scientific knowledge, identify questions and describe facts to be able to understand and make conclusions

about the universe and changes to nature due to human activities. The ability of the scientific literacy context can be achieved through the first step in implementing problem based learning, namely directing students to problems. Students begin to think about applications or phenomena related to science that exist both in the school environment and around their homes. The second step in PBL, namely organizing students to learn is related to indicators of knowledge in scientific literacy. In this phase students begin to collect various information about the problems they encounter in the environment and understand them with the basic knowledge they have.

The next steps in problem based learning are conducting investigations, developing and presenting the work, as well as analyzing and evaluating the problem-solving process. These three steps are related to scientific literacy competency indicators. Based on the phenomena that occur and the knowledge possessed by students, they are able to formulate specific problems, analyze all the information collected, construct causal relationships, and find various possible solutions to solve problems. Then among the several solutions students are able to take the best solution as a conclusion. Indicators of scientific literacy attitudes can be found from every step of problem based learning that students go through. Attitude indicators include students' interest in science and

technology, assessment of scientific approaches to investigations, and perceptions and awareness of the surrounding environment (Betari, 2016). The attitude of scientific literacy raises students' sensitivity to their environment so that they try to find solutions to phenomena that occur in order to achieve balance in life.

The results of this study indicate that there ws an increase in students' scientific literacy skills through problem based learning. This is in accordance with the findings (Betari, 2016; Mundzir, 2017). The general low ability of scientific literacy in cycle I was caused by students not being familiar with the application of problem-based learning models. Students' thinking is still focused on the theories they learn, while the application of science, students' interest and scientific competence still need to be improved. In cycle II, the percentage of scientific literacy indicators increased after improvements were made from cycle I and students had begun to be trained in applied learning.

The learning process using the problem-based learning model makes students more enthusiastic in participating in the learning process, students are more active, interested and concentrated so that scientific literacy skills can increase. This is consistent with the advantages of using problem-based learning models (Kurniasih, 2016), including: increasing students' creativity and critical thinking; motivating students to learn; help transfer students' knowledge in new situations; motivating students to be creative and innovative in proving problem investigations; foster a desire to work together and can develop good relationships in group work.

CONCLUSION

Students' scientific literacy skills have increased through the application of problembased learning models using classroom action research methods. The results showed that there was an increase in each indicator of scientific literacy. The steps taken in problem-based learning have led students to achieve aspect by aspect in scientific literacy. Students are able to present the context of science in everyday life, explain it based on their knowledge, collect information, conduct investigations, and determine the best solution to the problems encountered. The attitude of students with awareness of the environment has awakened a sense of responsibility in students to be able to do their best in maintaining the balance of life in the universe. Therefore, this problem-based learning model needs to be applied in schools, especially in basic education to be able to hone and develop students' scientific literacy skills.

Reference

Arends, Richard. 2012. Learning To Teach (9th ed.). New York: McGraw-Hill.

Astuti, R. A. 2017. Pembelajaran Berbasis Masalah Untuk Meningkatkan Literasi Sains Pada Materi Hubungan Makanan Dengan Kesehatan. Jurnal Pena Ilmiah , 261-270

Bagasta, A. R. et al. 2018. Profil Kemampuan Literasi Sains Peserta Didik di Salah Satu SMA Negeri Kota Sragen. Pedagogia: Jurnal Pendidikan , 7 (2), 121-129

Betari, Mutiara Eka, Novi Yanthi, and Dewi Rostika. 2016. Peningkatan Kemampuan Literasi Sains Siswa Melalui Penerapan Model Pembelajarn Berbasis Maalah Pada Pembelajaran IPA Di SD. Antologi UPI , 1-17.

El Islami, R. A. 2015. Hubungan Literasi Sains Dengan Kepercayaan Diri Siswa Pada Konsep Asam Basa. Jurnal Penelitian dan Pembelajaran IPA , 1 (1), 16-25.

Fazilla, S. 2016. Kemampuan Literasi Sains Mahasiswa PGSD Pada Mata Kuliah Konsep Dasar Sains. Jurnal Pendidikan Dasar , 3 (2), 22-28

Kemdikbud. 2017. Materi Pendukung Literasi Sains. Jakarta: Direktorat Jenderal Pendidikan Dasar dan Menengah, Kementrian Pendidikan dan Kebudayaan.

Kurnia, F. Z. 2014. Analisis Bahan Ajar Fisika SMA Kelas XI di Kecamatan Indralaya Utara Berdasarkan Kategori Literasi Sains. Jurnal Inovasi & Pembelajaran Fisika , 1 (1), 43-47.

Kurniasih, I., and B. Sani. 2016. Ragam Pengembangan Model Pembelajaran: Untuk Peningkatan Profesionalitas Guru. Jakarta: Kata Pena.

Mundzir, Muhammad Fahri, Atep Sujana, and Julia. 2017. Problem-Based Learning Untuk Meningkatkan Kemempuan Literasi Sains Siswa SD. Jurnal Pena Ilmiah , 2 (1), 421-430.

Nofiana, M., and T. Julianto. 2017. Profil Kemmpuan Literasi Sains Siswa SMP di Kota Purwokerto Ditinjau Dari Aspek Konten, Proses, Dan Konteks Sains. Jurnal Sains Sosial dan Humaniora , 1 (2), 77-84.

OECD. (2017). PISA 2015 Asesment and Analytical Framework: Science, Reading, Mathematic, Financial Literacy and Collaborative Problem Solving (revised ed.). Paris: OECD Publishing.

OECD. 2019. PISA 2018 Insights and Interpretations. Paris: OECD Publishing.

Rini, Candra Puspita, Saktian D. Hartantri, and Aam Amaliyah. 2021. Analisis Kemampuan Literasi Sains Pada Aspek Kompetensi Mahasiswa Program Studi PGSD FKIP Universitas Muhammadiyah Tangerang. Jurnal Pendidikan Dasar Nusantara, 6 (2), 166-179.

Tohir, M. (2016). Hasil PISA Indonesia Tahun 2015 Mengalami Peningkatan. Taken from https://matematohir.wordpress.com/2016/12/08/hasil-pisa-indonesia-tahun-2015-mengalami-peningkatan.

Undang-Undang Republik Indonesia Nomor 20 Tahun 2003 Tentang Sistem Pendidikan Nasional. 2004. Bandung: Citra Umbara.

Utami, D. 2018. Upaya Peningkatan Literasi Sains Siswa Dalam Pembelajaran IPA. Prosiding Seminar Nasional MIPA IV Banda Aceh. Banda Aceh.

Utami, S., and T. Sabri. 2014. Pengaruh Model Pembelajaran Berbasis Masalah Terhadap Kemampuan Literasi Sains IPA Kelas V SD. Jurnal Pendidikan dan Pembelajaran , 3 (7).

Wulandari, Nisa, Hayat Sholihin. 2015. Penerapan Model Problem Based Learning (PBL) Pada Pembelajaran IPA Terpadu Untuk Meningkatkan Aspek Sikap Literasi Sains Siswa SMP. Prosiding Simposium Nasional Inovasi dan Pembelajaran Sains 2015 (SNIPS 2015), (hal. 437-440). Bandung.

Yuliati, Y. (2017). Literasi Sains Dalam Pembelajaran IPA. Jurnal Cakrawala Pendas , 3 (2), 21-28.