

Application Of Science Process Skills to Improve Students' Scientific Literacy Abilities in Physics Learning

Dzikrul Rizki^{1*}, Miswatul Hasanah², Meriza Fardilla³

¹Universitas Bina Bangsa Getsempena, Banda Aceh, Indonesia

²Universitas Bina Bangsa Getsempena, Banda Aceh, Indonesia

³Universitas Bina Bangsa Getsempena, Banda Aceh, Indonesia

* Corresponding email: dzikrul@bbg.ac.id

ABSTRACT

Science process skills are directed scientific skills that can be used to discover a concept or principle or to develop existing concepts. Science process skills are an essential dimension of scientific literacy. However, observations and interviews conducted at SMA Unggul Subulussalam revealed that students' scientific literacy skills are still low. The purpose of this study is to determine the difference in the improvement of students' scientific literacy skills taught using the science process skills approach compared to those taught using the direct instruction model in Physics learning. This study employs a quantitative approach with a Non-Equivalent Control Group Design experimental method. The population of this study consists of 11th-grade science students (MIA), with a sample of 30 students selected through random sampling. The instrument used in this study is a multiple-choice test. The research data were analyzed using average tests, N-gain, and independent sample t-tests. The results indicate that the average N-gain score for scientific literacy in the experimental class is 0.76 (high category), while the N-gain score in the control class is 0.58 (moderate category). Furthermore, based on the results of the independent sample t-test, it can be concluded that there is a significant difference in the improvement of students' scientific literacy skills in Physics learning when taught using the science process skills approach compared to the direct instruction model.

Keywords: *Science Process Skills, Science Literacy Skills*

INTRODUCTION

Science literacy plays an important role in catalyzing science learning in the 21st century. Students must be prepared to be scientifically literate in order to solve scientific problems. Science literacy has been established as the

main objective of the science education curriculum, in 2015 (Yuenyong, 2018). Indonesia is ranked below in terms of science literacy skills compared to other Asian countries.

According to Winata et al. (2018), scientific literacy is the knowledge and understanding of scientific concepts and processes needed in making personal decisions, contributing to cultural and social activities, and economic productivity. In line with previous opinions, Gormally et al. (2012), defines scientific literacy as a person's ability to distinguish scientific facts from various information, recognize and analyze the use of scientific investigation methods and the ability to organize, analyze, interpret quantitative data and scientific information.

The results of a survey conducted by the Programme for International Student Assessment (PISA) showed that the scientific literacy scores of Indonesian students were 393, 395, 395 for the years 2000, 2003, and 2006, respectively (Bybee et al, 2018). The results of the 2009 PISA survey showed that Indonesia's scientific literacy score reached 383 and was ranked 57th out of 65 countries (Winata et al, 2018). The results of the 2012 PISA survey showed that Indonesia's scientific literacy score was 382 and was ranked 63rd out of 64 countries (OECD, 2013). In line with the results of the survey conducted by PISA, based on a survey conducted by Trends in International Mathematics and Science Study (TIMSS) which is conducted every four years in 2007 Indonesia was ranked 35th out of 49 countries and in 2011 Indonesia was ranked 40th out of 42 countries (NCES, 2012). The latest developments in the results of PISA in 2018, especially in scientific literacy, Indonesia is ranked 70th out of 78 countries (OECD, 2018). These results indicate that Indonesia's average scientific literacy score is below the international average score.

One of the important dimensions in scientific literacy is science process skills. Science process skills are the skills needed to acquire, develop, and apply scientific concepts, principles, laws, and theories, whether in the form of mental skills, physical skills (manual), or social skills (Zamista, 2015). Science process skills are the skills needed in conducting research and solving problems (Maknum 2012). The development of students' process skills will be able to find and develop their own facts and concepts and foster the required value attitudes (Hasbullah 2016).

Based on the author's observations and interviews with physics teachers at SMAN Unggul Subulussalam, the physics learning process has been introduced to scientific literacy. The scientific literacy of students at the school is still low. Scientific literacy at the school is categorized as low based on the assessment test that was tried out on students, where students obtained

scores on the minimum threshold. Students were unable to answer questions related to the scientific concepts of physics and scientific knowledge submitted by the teacher, this is also reinforced by the results of students' daily tests related to the scientific concepts of physics and scientific knowledge which are below the KKM, the average student gets a score below 60 which is far from the KKM limit of 70.

Based on these problems, teachers need to innovate in the teaching and learning process. Innovation in the teaching and learning process for a more effective and efficient learning process requires the application of models, methods or learning approaches that can improve student literacy that encourage students to solve a problem (Amar et al., 2020; Fitriyanti et al., 2021). The science process skills approach is one of the science learning approaches that is very important for scientific investigation (Kruea-In & Thongperm, 2015; Juhji, 2016; Alatas & Fachrunisa, 2018). The science process skills approach is an approach to science learning that involves mental and physical skills that include three aspects of psychomotor, affective, and cognitive skills that can be applied in scientific activities. In learning, the science process skills approach provides opportunities for students to be actively involved so that interactions can be formed between process skills and facts, concepts, and principles of science that can foster students' scientific attitudes (Juhji, 2016). In this process skills approach, students are invited to learn to observe, classify, measure, use numbers, guess, conclude and communicate the objects studied. In addition, students are also invited to be able to identify variables, form hypotheses (Kruea-In, 2015)

METHODS

In this study, the researcher used a quantitative approach with a quasi-experimental research type. The research design used in this study is Non-Equivalent Control Group Design. This study used two classes, namely the experimental class and the control class. The experimental class is a class that receives treatment by implementing KPS with KPS Steps, while the control class is a comparison class that only uses direct learning models in its learning such as lectures and also presentations explained on the board. The experimental class and control class in this study were given a pretest and posttest to see the differences in scientific literacy abilities of the two classes. The Non-Equivalent Control Group Design design in this study can be seen in Table 3.1.

Tabel 3.1 Research Design Nonequivalent Control Group Design

experiment	O_1	X_1	O_2
control	O_1	X_2	O_2

The learning process in this study applies KPS carried out in learning and also with direct model learning, where in the learning process in this study using two classes, namely the experimental class and the control class. The experimental class was given treatment to apply KPS, while the control class was given treatment with direct model learning according to the learning model implemented in the learning process at the school. Both classes at the beginning before learning will be given a pretest to determine the basic abilities possessed by students related to the concept of Sound Waves, after the end of the learning process students will be given a posttest to determine the extent of students' scientific literacy abilities related to the concept of Sound Waves after learning. The provision of pretests and posttests is done by giving questions to students, where questions are used to see students' scientific literacy abilities.

RESULTS AND DISCUSSION

The scientific literacy ability of students in this study, all data obtained were measured using questions that had passed the feasibility test as many as 7 in the form of descriptions, where the questions used were analyzed using Microsoft Excel to see the average value obtained related to pretest and posttest data and N-gain on students' scientific literacy abilities. Questions related to scientific literacy abilities were given to students twice, where the first was during the pretest and the second was during the posttest.

Based on the results of the study, the average posttest value of the experimental class was higher than that of the control class and there was an increase in students' scientific literacy abilities as seen from the N-gain value in the experimental class and control class. The value of the results of the research analysis obtained related to the increase in students' scientific literacy abilities can be seen briefly in Table 4.1

Tabel 4.1 Improving Science Literacy Skills in Experimental and Control Classes

Class	Average Score of Students' Science Literacy Skills		N-gain	Category
	Pretest	Posttest		
Exsperiment	33	84	0.76	High
Control	32	72	0.58	currently

The results of students' scientific literacy skills as seen from the pretest and posttest scores and the N-gain scores in Table 4.1 above show that the pretest scores of the two classes are relatively the same and are still very low, this indicates that students' understanding of the material on traveling waves and stationary waves is still very low, where for the experimental class the pretest score obtained was 33 and for the control class it was 32, while the average posttest score obtained in the experimental class was 84, which was greater than the control class which was only 72. These results indicate an increase in students' scientific literacy skills regarding the material on Sound Waves.

Based on the results of the application of science process skills, there is an increase in students' scientific literacy skills in physics learning on sound wave material. Implementation of the science process skills approach is one solution to improving students' scientific literacy. The results of the study by Asyhari, et al. (2015) showed that students' scientific literacy skills before and after the implementation of science process skills learning were not the same, or in other words, it can be said that there is a significant difference between students' scientific literacy skills before and after the implementation of science process skills learning. The results of this study indicate that science process skills learning can improve the profile of students' scientific literacy skills in the competency and knowledge aspects. Safitri, et al. (2016) also concluded that science learning using the science process skills approach has been proven to improve students' scientific literacy skills. Furthermore, Novili, et al. (2017) proved that the application of the science process skills approach can train scientific literacy in the competency domain and knowledge domain of junior high school students in science subjects. The results of the normalized gain analysis showed that the competency domain and knowledge domain increased in the moderate category. Science process skills learning invites students to observe various phenomena that are familiar to students' daily lives. Through this observation activity, students are expected to be able to find problems related to the concept of knowledge that they will learn (Asyhari, et al., 2015). Observation of a phenomenon directly or through its simulation provides meaning for students.

Based on previous research conducted by Yuliani (2016), the learning activities of students when implementing science process skills-based learning at each meeting always increased. Very strong criteria are found in the activities of planning experiments and observing (observation). Sufficient criteria are found in the activities of interpreting data, classifying and communicating. Sufficient and very strong criteria prove that science process skills-based learning (KPS) is able to increase student activities in learning. There is a significant difference in the increase in students' scientific literacy

between the experimental class and the control class. The average N-Gain value of the experimental class is 0.3239 indicating moderate criteria, and the average N-Gain value of the control class is 0.2332 indicating low criteria. Students provide strong and very strong responses to the implementation of science process skills-based learning. Other results also show that there is a positive relationship between science process skills and scientific literacy (Handayani, 2018).

Similar research conducted by (Hidayah, 2019) that the application of science process skills can improve scientific literacy skills. The scientific literacy skills of the competency domain of junior high school/MTs students in Pati Regency include students' abilities in explaining scientific phenomena, the average percentage reaches 28.64%, students' abilities in evaluating and designing scientific investigations 24.48% and students' abilities in interpreting data and scientific evidence 31.81%.

The importance of developing scientific literacy skills in students. Scientific literacy is the ability to understand scientific concepts and their applications in real life. The form of application of these scientific concepts is mostly in the form of solving problems that exist in people's lives. Students who have scientific literacy skills will be responsive to existing problems, because in addition to understanding the concept, students also understand how to apply the knowledge they have in real life.

CONCLUSION

Based on the results of the research and data analysis, it was obtained that the average value of the N-gain of the experimental class's scientific literacy was 0.76, which is in the high category, and the average value of the N-gain of the control class was 0.58, which is in the moderate category. In addition, based on the results of the independent sample t-test, it can be concluded that there is a difference in the increase in students' scientific literacy skills in Physics learning taught using the science process skills approach with that taught using the direct learning model.

REFERENCES

- A'yun, S. N., & Subali, B. 2019. Sifat-Sifat Cahaya Dalam Discovery Learning Untuk Meningkatkan Keterampilan Proses Sains. *Jurnal Ilmu Pendidikan*, 24(2), 75.
- Abdullah, Mikrajuddin. 2017. *Fisika Dasar*. Institut Teknologi Bandung

Af'idayani, N., Setiadi, I., dan Fahmi. 2018. The Effect of Inquiry Model on Science Process Skills and Learning Outcomes. *European Journal of Education Studies*. 4(12): 177-182.

Afina, D. R., Hayati, M. N., & Fatkhurrohman, M. A. 2021. Profil Capaian Kompetensi Literasi Sains Peserta didik SMP Negeri Kota Tegal Menggunakan PISA. *PSEJ (Pancasakti Science Education Journal)*, 6(1), 10-21.

Alatas, F., & Fachrunisa, Z. 2018. Keefektifan Pogil dengan Laboratorium Virtual di Meningkatkan Keterampilan dan Sikap Proses Sains: Konsep Gerak Harmonik Sederhana. *EDUSAIN*,10(2), 327–334.

Amar, G. I., Suranto, S., & Sajidan, S. 2020. The Use of a Creative Problem Solving Based Genetic Mutation Module in Higher Education. *International Journal of Higher Education*, 10(3), 33.

Arikunto, S. 2013. *Prosedur Penelitian Suatu Pendekatan Praktik*. Jakarta: Renika Cipta.

Arikunto, S. 2016. *Prosedur Penelitian Suatu Pendekatan Praktik*. Jakarta: Rineka Cipta.

Astiti, K. A. 2017. *Evaluasi Pembelajaran*. Yogyakarta: Penerbit Andi

Astuputra, Dwi Aprilia & Hadma Yuliani. 2016. Penerapan Model Pembelajaran Learning Cycle Terhadap Motivasi Keterampilan Proses Sains pada Materi Pokok Cahaya. *EduSains*. Volume 4 Nomor 1.

Aydogdu, B., Erkol, M., dan Erten, N. 2014. The investigation of science process skills of elementary school teachers in terms of some variables: erspectives from Turkey. *Asia-Pacific Forum on Science Learning and Teaching*, Vol. 15, No.1, 28

Borich, Gary D. 1994. *Observation Skill for Effective Teaching*. New York: Mac Millian Publishing company.

Bybee, R., McCrae, B. & Laurie, R. 2009. PISA 2006: An Assesment of Scientific Literacy. *Journal of Research in Science Teaching*, 46 (8): 865-883.

Bybee, R.W. 1997. Toward an understanding of scientific literacy. In: W. Gräber & C. Bolte (Eds.). *Scientific literacy: An international symposium* (pp. 3768). Kiel, Germany: IPN.

Chabalengula, Vivien M., Frackson Mumba., dkk. 2008. Curriculum and Instructional Validity of the Scientific Literacy Themes Covered in Zambian High School Biology Curriculum. *International Journal of Environmental & Science Education* Vol. 3, No.4, October 2008, 207-220. USA.

Chiappetta, E.L, Fillman, D.`A, dan Sethna, G.H. 1993. Do Middle School Life Science Textbooks Provide a Balance of Scientific Literacy Themes?. *Journal of Research in Science Teaching*, 30 (2): 787–797.

Chiappetta, E.L, Fillman, D.A, dan Sethna, G.H. 1991. A Method to Quantify Major Themes of Scientific Literacy in Science Textbooks. *Journal of Research in Science Teaching*, 28 (8): 713-725.

DeBoer, G.E. 2000. "Scientific Literacy: Another Look at Its Historical and Contemporary Meanings and Its Relationship to Science Education Reform". *Journal of Research in Science Teaching* Vol. 37, no. 6

Dimiyati dan Mudjiono. 2013. *Belajar dan Pembelajaran*. Jakarta: Rhineka Cipta.

Drake A. R, Wong, Jeffrey and S. B. Salter. 2007. Empowerment, Motivation, and, Performance: Examining the Impact of Feedback and Incentives on Nonmanagement Employees. *Behavioral Research In Accounting* 19: 71-89.

Duda, H.J., Herawati, S., dan Peter, N. 2019. Enhancing Different Ethnicity Science Process Skills: Problem-Based Learning through Practicum and Authentic Assessment, *International Journal of Instruction*, 12(1):12081222

Ebel,R.L & Frisble ,D.A. 1986. *Essentials of Educational Measurement*, New Jersey: Prentice Hall

Fathurohman, A., Zulherma, dan F. Kurnia. 2014. Analisis Bahan Ajar Fisika SMA Kelas IX di Kecamatan Indralayu Utara Berdasarkan Kategori Literasi Sains. *Jurnal Inovasi dan Pembelajaran Fisika*. 1 (1): 43-47.

Fitriani. 2016. Penerapan Keterampilan Proses Sains (KPS) dalam Meningkatkan Hasil Belajar Tekanan Zat cair pada Peserta didik MTsN Kuta Baro Aceh Besar, *Jurnal Ilmiah Mahapeserta didik (JIM) Pendidikan Fisika*. Vol. 1 No.4 Oktober 2016

Fitriyanti, L. D. 2021. Penerapan Model Pembelajaran Creative Problem Solving Untuk Meningkatkan Kemampuan Pemecahan Masalah Soal Cerita Interpretasi Data. *Kalam Cendekia: Jurnal Ilmiah Kependidikan*, 9(1), 258–262.

Gormally, C., Brickman, P., & Lutz, M. 2012. Developing a test of scientific literacy skills (TOSLS): Measuring undergraduates' evaluation of scientific information and arguments. *CBE Life Sci Educ*. 11(4): 364–377.

Hake, R. 1999. *Analyzing Change/ Gain Score*. Indiana: Indiana University.

Handayani, G., Adisyahputra, dan Indrayanti, R. 2018. Hubungan keterampilan proses sains terintegrasi dan kemampuan membaca pemahaman terhadap literasi sains pada mahapeserta didik calon guru biologi. *Biosfer: Jurnal Pendidikan Biologi*, 11(1):21-31.

Haryono. 2006. Model Pembelajaran Berbasis Peningkatan Keterampilan Proses Sains. *Jurnal Pendidikan Dasar* Vol.7, NO.1: 1-13: UNNES

Hasbullah. 2016. Pengembangan Lembar Kerja Peserta didik Berorientasi Keterampilan Proses Dalam Pembelajaran Saintifik Terhadap Hasil Belajar Peserta didik Pada Pokok Bahasan Sistem Pencernaan Manusia, *jurnal Pendidikan Biologi*, 7(2): 123-124

Holbrook, J. & Rannikmae, M. 2009. The Meaning of Scientific Literacy. *International Journal of Environmental & Science Education*, 4(3), 275-288.

Holbrook, J. & Rannikmae, M. 2016. The Meaning of Scientific Literacy. *International Journal of Environmental & Science Education*, 5(2), 280-298.

Huryah, F., Sumarmin, R., dan Effendi, J. 2017. Analisis Capaian Literasi Sains Biologi Peserta didik SMA Kelas X Di Kota Padang, *Jurnal Eksakta Pendidikan*, 1(2): 72 -79.

Asyhari, A., & Hartati, R. 2015. Profil Peningkatan Kemampuan Literasi Sains Melalui Pembelajaran Saintifik. *Jurnal Ilmiah Pendidikan Fisika Al-Biruni* 04(2), 179-191.

Handayani, G., Adisyahputra., & Indrayanti, R. 2018. Hubungan Keterampilan Proses Sains Terintegrasi dan Kemampuan Membaca Pemahaman Terhadap Literasi Sains Pada Mahasiswa Calon Guru Biologi. *Jurnal Pendidikan Biologi(BIOSFERPJB)* 11(1), 21-31.

Hidayah, N., & Kurniawati. 2021. Pengaruh Pembelajaran Problem Based Learning Berbasis Blended Learning terhadap Kemampuan Literasi Sains. *Jurnal Pendidikan Biologi Biodusiana*. 6 (2).

Ilgaz, G., Eskici, M., & Vural, L. 2019. Which Country is More Effective in Science Teaching? Evidence from PISA 2015 as a Secondary School Assessment Tool Which Country is More Effective in Science Teaching? Evidence from PISA 2015 as a Secondary School Assessment Tool. *Asian Journal of Education and Training*, 5 (2), 341-361.

Istyowati, A. 2017. Analisis Pembelajaran Dan Kesulitan Peserta didik Sma Kelas Xi Terhadap Penguasaan Konsep Fisika. *Jurnal Prosiding Seminar Nasional III Universitas Negeri Malang*.

Juhji, J. 2016. Keterampilan Proses Sains Peserta didik melalui Pendekatan Peningkatan Inkuiri Terbimbing. *Jurnal Penelitian dan Pembelajaran IPA*, 2(1), 58–70.

Jumadin L. 2017. Perlunya Pembelajaran Modeling Instruction Pada Materi Gelombang. *Jurnal Pendidikan: Teori, Penelitian, dan Pengembangan*.

Juniardi, A, C., & Nurita, T. 2019. Peningkatan Keterampilan Proses Sains Peserta didik Dengan Menerapkan Model Pembelajaran Discovery Learning pada Sub Materi Sifat-sifat Cahaya. *Pensa E-Jurnal:Pendidikan Sains*, 7(2).

Khaldun, I. 2017. Proanal Tes V6 Program Analisis Butir Soal dan Penilaian Hasil Belajar. Banda Aceh: Prodi Pendidikan Kimia, FKIP Unsyiah.

Komikesari, H. 2016. Peningkatan keterampilan proses sains dan hasil belajar fisika peserta didik pada model pembelajaran kooperatif tipe student team achievement division. *Tadris: Jurnal Keguruan dan Ilmu Tarbiyah*, 1(1):15-22.

Kruea-In, C., Kruea-In, N., & Fakcharoenphol, W. 2015. A Study of Thai In-Service and Pre-Service Science Teachers' Understanding of Science Process Skills. *Procedia – Social and Behavioral Sciences*, 197, 993–997.

Liliasari. 2011. Pengembangan Keterampilan Generik Sains untuk Meningkatkan kemampuan Berpikir Kritis Peserta Didik. Makalah -Joint -Sem UiTM

Maknun. D. 2014. Penerapan Pembelajaran Kontekstual Untuk Meningkatkan Literasi Sains dan Kualitas Argumentasi Peserta didik Pondok Pesantren Daarul Uluum PUI Majalengka pada diskusi Sosiainstifik IPA, *JURNAL TARBIYAH*, Vol. 21, No.1

Ningrum, P., Budiyanto, M., Susiyawati, E. 2019. Penerapan Model Pembelajaran Guided Inquiry dengan LKPD Berbasis Scaffolding untuk Melatihkan Keterampilan Proses Sains Peserta didik. *PENSA E-JURNAL: Pendidikan Sains*, 9(3): 399- 406.

Nurfaidah, S.S. 2017. Analisis Aspek Literasi Sains pada Buku Teks Pelajaran IPA. *Mimbar Sekolah Dasar*, 4(1), 56-66.

OECD. 2007. *PISA 2006 Science Competencies for Tomorrow's World. Volume 1: Analysis Paris: OECD.*

OECD. 2013. *PISA 2018 Result (Volume 1): What students Know and Can Do, PISA, OECD Publishing, Paris*

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

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

OECD. 2016. *PISA 2015 Results (Volume I): Excellence and Equity in Education, PISA. Paris: OECD Publishing.*

OECD. 2016c. *Science performance (PISA) (indicator). Paris: OECD Publishing.*

OECD. 2018. *PISA 2015 Results (Volume II): Excellence and Equity in Education, PISA. Paris: OECD Publishing.*

OECD-PISA. 2006. *Assessing Scientific, Reading and Mathematical Literacy: A Framework for PISA 2006.*

Olsen, Rolf Vegar. 2016. *The OECD PISA assessment of scientific literacy: how can it contribute to science education research. OECD Programme for International Student Assessment.*

Rohmah, I. L., & Hidayati, S. N. 2021. Analisis Literasi Sains Peserta Didik SMPN 1 Gresik. *Pensa E-Jurnal: Pendidikan Sains*, 9(3), 363-369.

Sakdiah., Mursal. dan Syukri, M. 2018. Penerapan model inkuiri terbimbing untuk meningkatkan pemahaman konsep dan kps pada materi listrik dinamis peserta didik SMP. *Jurnal IPA dan Pembelajaran IPA*. 2(1):41-49.

Sholahuddin, A., & Sari, Mella Mutika. 2016. Tingkat Literasi Sains Peserta didik Smp Kotamadya Banjarmasin. Prosiding Seminar Nasional Pendidikan IPA.

Shwartz, W., Ben-Zvi, R., dan Hofstein, A. 2006. The Importance of Involving High School Chemistry Teacher in the Process of Defining The Operational Meaning of ‘Chemistry Literacy’, *International Journal of Science Education*, Vol 27, No 3, Hal 323—344.

Singarimbun, M. dan Effendi, S. 1995. *Metode Penelitian Survai*. Jakarta: PT Pustaka LP3ES Indonesia.

Subali, Bambang. 2011. Pengukuran Kreativitas Keterampilan Proses Sains dalam Konteks Asessment For Learning. *Cakrawala Pendidikan*, 1(1), 130-144.

Keterampilan Proses Sains. *Jurnal Inovasi Pendidikan IPA*, vol 2(2): 252-261

Sudarisman, S. 2010. Membangun Karakter Peserta Didik Melalui Pembelajaran Biologi Berbasis Keterampilan Proses. *Seminar Nasional Pendidikan Biologi*. FKIP UNS: Surakarta

Sugiyono. 2015. *Metode Penelitian Pendidikan: Pendekatan Kuantitatif, Kualitatif, dan R&D*. Bandung: Alfabeta

Sugiyono. 2018. *Metode Penelitian Kuantitatif*. Bandung: Alfabeta.

Sukarno, Permanasari, A., & Hamidah, I. 2013. Science Teacher Understanding to Science Process Skills and Implications for Science Learning at Junior High School (Case Study in Jambi). *International Journal of Science and Research (IJSR)*, 2(6), 450-454.

Sukarno., Permanasari, A., & Hamidah, I. 2013. The Profile of Science Process Skill (SPS) Student at Secondary High School (Case Study in Jambi). *International Journal of Scientific Engineering and Research*. 1(1): 79-83.

Sundayana, R. 2016. *Statistika Penelitian Pendidikan*. Bandung: Alfabeta.

Wenning, C.J. & Wenning, R.E. 2006. Assessing Nature-Of-Science Literacy as One Component of Scientific Literacy. *Journal of Physics Teacher Education Online*, 3(4),3-14.

Wenning, Carl. 2006. A Framework for Teaching The Nature Of Science. *J. Phys. Tchr. Educ. Online*,3(3), March 2006. Illinois State University Physics Dept.

Winata, et.al. 2018. Kemampuan Awal Literasi Sains Peserta Didik Kelas V SDN Sidorejo I pada Materi Daur Air. 2(1), 58-64. Mei. JTIEE.

Yinda. 2008. Pendekatan Keterampilan proses pembelajaran IPA dalam mengajarkan IPA Biologi

Yuenyong, C., & Narjaikaew, P. 2018. Scientific literacy and thailand science education. *International Journal of Environmental & Science Education*, 4 (3), 335-349.

Yuliani, Y. 2016. Penerapan Pembelajaran IPA Berbasis Keterampilan Proses Sains untuk Meningkatkan Literasi

Yusrizal & Rahmati. 2020. Tes Hasil Belajar. Banda Aceh: Bandar Publishing.

Zamista, A. 2015. Pengembangan Tes Keterampilan Proses Sains Materi Fluida Statis Kelas X SMA/MA (Pdf Online).

Zuhara, E., Jufri, A. W., & Soeprianto, H. 2019. Kemampuan Literasi Biologi Berdasarkan Gender Pada Peserta didik Peminatan Mipa Di Sma Negeri Kabupaen Lombok Barat. *Jurnal Penelitian Pendidikan IPA*, 5(1), 115–119.