SETS VISION: HOW TO DEVELOP STUDENTS' CLIMATE LITERACY THROUGH PHYSICS LEARNING?

Novia Eri Ekayanti, Eko Hariyono
Jurusan Fisika, Fakultas Matematika dan Ilmu Pengetahuan Alam, Universitas Negeri Surabaya
Email: noviaekayanti16030184050@mhs.unesa.ac.id

Abstract

Climate change is a severe global problem. The impact of climate change is widespread in all countries, including in Indonesia. Lack of public awareness of climate change is one of the causes of climate change getting out of control. One way of improving public awareness is to develop society's climate literacy through students at school. Starting from this problem, the researcher offered an innovation in physics learning with the SETS (Science, Environment, Technology, and Society) vision on global warming material as a solution to develop students' climate literacy. This research aims to develop students' climate literacy through SETS vision learning. This quantitative research with quasi-experimental design and non-equivalent control group design. The subjects in this research were class XI MIA 5 and XI MIA 8. The data analysis method used is the test method consists of pre-test and post-test. Climate literacy ability was analyzed using paired t-test and gain index. The results showed that the climate literacy ability of students after applying the SETS vision has increased higher than the class with regular teaching. The n-gain score of students' climate literacy in the experimental class was 0.70 classified as a high category while in the control class was 0.44 classified as a moderate category. Based on the results of the research, it conclude that the SETS vision was learning able to develop climate literacy of students on global warming material. Climate-literate students will have awareness and concern about climate change that occurs in the surrounding environment.

Keywords: the SETS vision learning, climate literacy, global warming.

Abstrak

Perubahan iklim merupakan permasalahan global yang sangat serius. Dampak perubahan iklim semakin meluas di seluruh negara termasuk di Indonesia. Kurangnya kesadaran masyarakat terhadap perubahan iklim menjadi salah satu penyebab perubahan iklim semakin tidak terkendali. Salah satu cara untuk meningkatkan kesadaran masyarakat yaitu dengan membangun literasi iklim masyarakat melalui peserta didik di sekolah. Berawal dari permasalahan tersebut, peneliti menawarkan inovasi pembelajaran fisika bervisi SETS (*Science, Environment, Technology, and Society)* pada materi pemanasan global sebagai solusi untuk membangun literasi iklim peserta didik. Tujuan penelitian ini adalah untuk membangun literasi iklim peserta didik melalui pembelajaran bervisi SETS. Jenis penelitian ini merupakan penelitian kuantitatif dengan *quasi experimental design* dan bentuk desain *non-equivalent control group*. Subjek dalam penelitian ini adalah kelas XI MIA 5 dan XI MIA 8. Metode analisis data menggunakan metode tes berupa *pre-test* dan *post-test*. Kemampuan literasi iklim dianalisis menggunakan uji t-berpasangan dan indeks *gain*. Hasil penelitian menunjukkan bahwa kemampuan literasi iklim peserta didik setelah diterapkan pembelajaran bervisi SETS mengalami peningkatan lebih tinggi daripada kelas dengan pengajaran biasa. Nilai *n-gain* literasi iklim peserta didik pada kelas eksperimen sebesar 0,70 dengan kategori tinggi sedangkan pada kelas kontrol sebesar 0,44 dengan kategori sedang. Berdasarkan hasil penelitian dapat disimpulkan bahwa pembelajaran bervisi SETS dapat membangun literasi iklim peserta didik melalui materi pemanasan global. Peserta didik yang berliterasi iklim akan memiliki kesadaran dan kepedulian terhadap perubahan iklim yang terjadi di lingkungan sekitar.

Kata Kunci: pembelajaran bervisi SETS, literasi iklim, pemanasan global.

INTRODUCTION

Climate change is a severe global problem. The Global Risk Report 2020 states that the most dominant cause of global problems comes from the environment caused by climate change (World Economic Forum, 2020). Climate change problems such as extreme weather, food and clean water crises, loss of biodiversity, and damage to human-made natural disasters. The impact of

climate change occurs on all countries, including Indonesia, which has extreme weather. Extreme weather harms on society which can give trouble to the economy, damage the environment, and also public health.

Extreme weather causing natural disasters such as floods and droughts in several regions of Indonesia. Based on data of the natural disasters' impacts in Indonesia from 1900-2016, floods are the most frequent natural disasters in years (Hariyono and Liliasari, 2018b). The increasing temperature has an immediate effect on the high distribution of global rainfall that causing floods (Loo *et al.*, 2015). One of the causes of temperature increase is the human activity which emits greenhouse gases.

The increasing temperature on the atmosphere is caused by human activity which is going to change weather and climate patterns so that it can accelerate climate change (Lapan, 2017: 6). One effort to reduce the concentration of carbon dioxide caused by human activities is to improve self-awareness in every human being about the effects of climate change. Self-awareness can improve by giving people information about the understanding of climate change (climate literacy) such as causes, impacts, and prevention/mitigation to reduce people's behaviour which can cause climate change. This information can obtain from various sources, one of them through learning in schools.

Subjects which is appropriate to these problems are physics. Physics is a part of natural sciences which is very closely related to the process of observing phenomena in the universe through a scientific approach (Festiyed and Yulkifli, 2013). One of the physics material that is related to climate change is a matter of global warming. According to PISA 2015, global climate subjects is one of the category of energy in the earth system, which is part of scientific knowledge (OECD, 2017: 28).

Based on the results of a preliminary study such as questionnaires and interviews, 90% of students have not understood toward global warming material and climate change because teachers do not teach students deeply about that material and assume that students can learn the content themselves. It is the same as the research by Gunamantha and Dantes (2019) that most students know climate changes in the moderate category. As a results students' climate literacy need to develop through learning about relevant subjects to build awareness of climate change.

The appropriate learning model applied to global warming material to develop students' climate literacy is the "SETS vision" learning. The SETS vision learning asks students to associate the elements of science in the material which are studied by aspects of the environment, technology, and society (Atminiati and Binadja, 2017). Students can get information on the content which are being considered and observe the objects that are around the school by utilizing the school environment. Students can also interact with society to find information, so students taught to use the environment and the community to get information about the material which studied (Widiantini *et al.*, 2017: 143). According to Supriyadi *et al.* (2019), the "SETS vision" learning can indirectly improve students' awareness and empathy toward the environment and society.

The characteristics of SETS vision learning according to Khasanah (2015) are as follows:

1. Starting from identifying local problems/issues.
2. Students are learning using local resources.
3. Students actively participate in finding information to solve problems in daily life.
4. Learning emphasizes the process skills of students that can use to solve problems.
5. Students have the opportunity to gain experience in solving problems which have identified.

The SETS vision learning syntax consists of 5 phases. Those invitation, exploration, application and solution, concept strengthening, and evaluation (Poedjiadi, 2010: 131).

Climate literacy is an understanding of the influence of the society on climate and the influence of climate on the society (Miler and Sladek, 2011: 152). "Climate literacy" is part of scientific literacy because the climate is part of science, especially earth science (Azevedo and Marques, 2017: 4). Climate literacy indicators adapted from scientific literacy indicators developed from scientific literacy competencies that explain scientific phenomena, evaluate and design scientific enquiry, interpret data and evidence scientifically (OECD, 2017: 22). Students' climate literacy can develop through learning which integrates elements of science, environment, technology, and society into learning material. The relationship between the elements of SETS and climate literacy has shown in Figure 1.

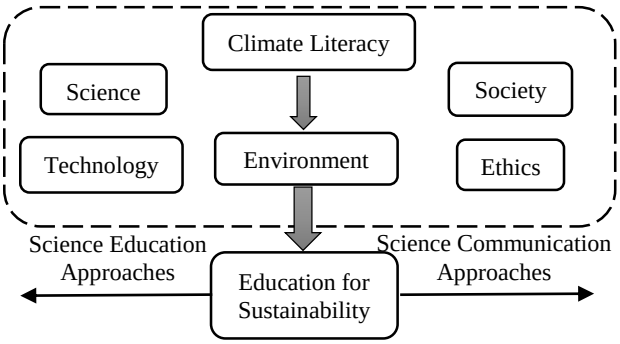

Figure 1. Framework for The Relationship of SETS Elements in Develop Students' Climate Literacy (Source: Azevedo and Marques, 2017: 11)

Collaboration between science, technology, society, and ethics is needed to develop students' climate literacy through science education approaches (physics learning) based on the environment (Azevedo and Marques, 2017: 12). Beside of that, the SETS vision also has a relationship with climate literacy when viewed from the syntax of the SETS vision and climate literacy indicators. The relationship between the SETS vision and students' climate literacy has shown in Table 1.

Table 1. The Relationship of The SETS Vision with Climate Literacy

Syntax of SETS Vision	Climate Literacy Indicators
Invitation Studennts are identifying questions climate in the form of phenomenon problems which have been presented by teachers to stimulate students' curiosity and process to overcome challenges.	(1) Distinguish scientific and non-scientific questions about the phenomenon.
Exploration Understanding and learning questions in the form of problems provided by finding information and data through reading, observing, interviewing, discussing, conducting scientific investigations, and analyzing the results of the data investigations.	(2) Explain the concepts of climate science from a problem or phenomenon. (3) Plan how to explore scientific questions. (4) Transform data from one representation to others and analyze the results of investigations about the phenomenon of climate change.
Solution Make a report on the results of an investigation conclude, communicate the results of scientific studies.	(5) Conclude the results of investigations about the phenomenon of climate change.
Application Apply scientific concepts found in scientific phenomenon to technology and society. ***Concept strengthening*** Straighten understanding of students' concepts during learning and reflect the implications of scientific knowledge to technology and society.	(6) Explain the application of technology to overcome climate change. (7) Explain the implications of climate change to society and otherwise.

(Adapted from Poedjiadi, 2010: 131; OECD, 2017: 26)

Based on Table 1, it can see that the syntax of the SETS vision has a relationship and suitable with the indicators of climate literacy so that the SETS vision learning can be applied to develop students' climate literacy. As it is stated by (Nurkaenah *et al.,* 2019) that the application of the SETS (Science, Environment, Technology, and Society) approach can develop students' scientific literacy. Based on this background, the author's interest to conduct research entitled "SETS Vision: How to Develop Students' Climate Literacy through Physics Learning?".

METHOD

This research is a quantitative descriptive study which uses a quasi-experimental research design. The form of design used the non-equivalent control group. This research consists of 2 groups. They are the control group and the experimental group, which were not randomly selected (Sugiyono, 2018: 116). The sample in this research were students from 2 classes of XI MIPA. Determination of the sample in this research using purposive sampling. Purposive sampling used because the population has determined with specific considerations.

Both classes gave a pre-test to find out the initial state. After being given a pre-test, the experimental class is given treatment in the form of SETS vision learning while the control class gave treatment in the way of learning that usually takes place in schools (regular education). This learning carried out by two meetings in each group of class. The research ended with a post-test given to both classes. Based on the research design which has explained, a description of the non-equivalent control group research design presented in Table 2.

Table 2. Research Design of Non-equivalent Control Group

Class	Pre-test	Treatment	Post-test
Experiment	O_1	X_1	O_2
Control	O_3	X_0	O_4

(Sugiyono, 2018:116)

Data collection methods in this research use test methods in the form of pre-test and post-test given to the control and experimental class. The test instruments are arranged based on climate literacy indicators, which considered as the achievements to develop students' climate literacy. Before the test instrument given to the students, it validated by two Unesa's Physics lecturers. Test instrument reliability between 2 observers calculated using the percentage of agreement equation.

Data analysis techniques in this research consists of paired t-test and gain index (n-gain). The paired t-test used to determine the ability of students' climate literacy after participating in the physics learning process using the SETS vision. Before conducting the paired t-test, it is going to hold the pre-requisite test consists of a normality test and a homogeneity test. Normality test used to determine whether the research data distributed normally or not. Normality test determined using the Chi-square test. Homogeneity test used to find out whether the samples of the research come from populations that have homogeneous variances or not. Homogeneity test determined using the Bartlett test.

The n-gain analysis used to determine the level of students' climate literacy in the experimental and control classes. The test result data are in the form of essay questions with climate literacy indicators analyzed using the following formula:

$$\langle g \rangle \frac{\%\boldsymbol{g}}{\%\langle \boldsymbol{G_{maks}} \rangle} = \frac{(\%\langle \boldsymbol{S_f} \rangle - \%\langle \boldsymbol{S_i} \rangle)}{(\mathbf{100}\% - \%\langle \boldsymbol{S_i} \rangle)} \ldots\ldots\ldots\ldots\ldots \quad (1)$$

Information:

$\langle g \rangle$ = The improvement of students' climate literacy.
S_i = Initial average students' climate literacy (*pre-test*).
S_f = Final average students' climate literacy (*post-test*).

RESULTS AND DISCUSSION

The result of validity and reliability calculation presented in Table 3 and 4.

Table 3. Validity Result of Research Instruments

No.	Research Instruments	Validity Score	Criteria
1	Climate literacy test	3.25	Valid
2	Climate literacy test rubric	3.36	Valid

Table 4. Reliability Result of Research Instruments

No.	Research Instruments	Percentage of Agreement	Category
1	Climate literacy test	100%	Very High
2	Climate literacy test rubric	78.50%	High

Based on the results of calculations in Table 3, it can conclude that the test instrument and the rubric of the climate literacy test are confirmed to be valid based on the instrument validity criteria according to Ratumanan and Laurens (2011) so that the instrument can use for research. Based on the results of calculations in Table 4, it can conclude that the test instrument and the rubric of the climate literacy test are confirmed to be reliable because it has a percentage of agreement value >75% so that the test instrument can use for research (Borich, 1994).

Students' climate literacy is measured by using pre-test and post-test score. Pre-test and post-test score obtained from the 7 questions of climate literacy test containing climate literacy indicators. Pre-test and post-test given to the experimental class and the control class. The improvement of students' climate literacy was analyzed using paired t-test and n-gain based on the students' pre-test and post-test score. The paired t-test used to determine whether there are difference in the pre-test and post-test score of students. Before conducting the paired t-test, the pre-requisite test consists of a normality test and a homogeneity test. The results of the normality test and homogeneity test presented in Table 5 and 6.

Table 5. Normality Pre-Test Calculation Results

Class	X^2_{counts}	X^2_{table}	Conclusion
Experiment	8.100	12.592	H_0 accepted
Control	10.870	12.592	H_0 accepted

Table 6. Homogeneity Pre-Test Calculation Results

Class	X^2_{counts}	X^2_{table}	Conclusion
Experiment	0.013	3.841	H_0 accepted
Control			H_0 accepted

Based on Table 5 and 6, it is known that $X^2_{counts} \leq X^2_{table}$ with $\alpha = 0.05$ so it can conclude that H_0 accepted, which state that the pre-test score come from a normally distributed population and homogeneous. This result also means that the post-test score come from populations that are normally distributed and homogeneous because it come from the same population.

The pre-requisite tests have been conducted and stated that the value of the pret-test and post-test come from populations that are normally distributed and homogeneous. Furthermore, the paired t-test calculated using the Chi-square test with H_0 stated that there were difference in pre-test and post-test score which were not significant and H_1 stated that there were significant difference in pre-test and post-test score. The hypothesis testing criteria is that H_0 rejected or H_1 accepted if

$t_{counts} \geq t_{table}$. The results of the paired t-test calculations presented in Table 7.

Table 7. The Paired t-Test Calculation Results

Class	t_{counts}	t_{table}	Conclusion
Experiment	26.437	2.037	H_0 rejected
Control	16.155		H_0 rejected

Based on Table 7, the score of $t_{counts} \geq t_{tabel}$ which means H_0 rejected or there is a significant difference between pre-test and post-test score. It is because the previous students have never been get used to develop climate literacy in learning. It is as stated in the research of Zahara and Atun (2018) that there is a significant difference between pre-test and post-test score where the pre-test results are in the bad category because the previous students have never been get used to develop scientific literacy.

The improvement of students' climate literacy skills can be known using the gain index calculation. The pre-test and post-test results data in the form of essay questions with indicators of climate literacy were analyzed using the n-gain score. The n-gain score of students in the experimental and control classes presented in Table 8.

Table 8. Comparison of Average n-gain of Experiment and Control Classes

Class	Pre-test	Post-test	n-gain	Category
Experiment	27.09	77.55	0.70	High
Control	18.97	54.97	0.44	Moderate

Based on Table 8, the average n-gain score of the experimental class was 0.70 and the average n-gain score of the control class was 0.44. According to (Hakee, 1999), the average score of n-gain interpreted as the categories, which are low ($\langle g \rangle < 0.3$), moderate ($0.7 > \langle g \rangle \geq 0.3$), and high ($\langle g \rangle \geq 0.7$). It means that the improvement of climate literacy in the experimental class classified as a high category and in the control class classified as a moderate category so that the improvement of climate literacy in the experimental class is more significant than the control class. It is related to the research as conducted by Nurkaenah *et al.* (2019), which states that there is a significant influence of the SETS vision learning program toward the improvement of students' scientific literacy with the average improvement of scientific literacy in the experimental class higher than the control class.

The ability of students' climate literacy in the experimental class improved significantly compared to the control class. It is because in the experimental class applied learning with the SETS vision, which teaches students to identify environmental issues that are around to find a solution by scientific inquiry through practical activities. This can embody and develop students' climate literacy skills, which characterized by several indicators that are eligible during learning by using the SETS vision. As it is stated by Hariyono *et al.* (2018a), learning that integrates environmental problems can teach students to solve problems of environmental change based on scientific methods so that it expected to help society to solve environmental problems.

A comparison of the n-gain score for each climate literacy indicator in the experimental and control classes presented in the graph in Figure 2.

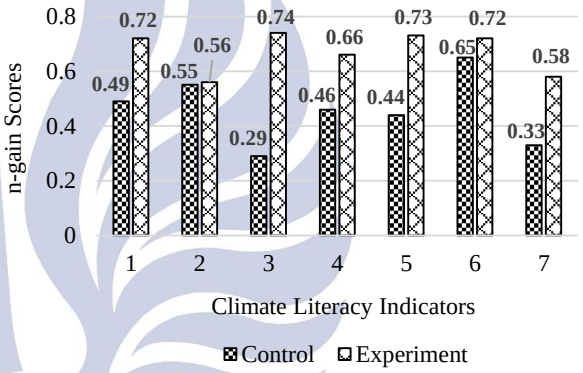

Figure 2. Comparison of The n-gain Score for Each Climate Literacy Indicator in The Experimental and Control Classes

Information:
1 = Explain the concepts of climate science from a problem or phenomenon.
2 = Distinguish scientific and non-scientific questions about the phenomenon.
3 = Plan how to explore scientific questions.
4 = Transform data from one representation to others and analyze the results of investigations about the phenomenon of climate change.
5 = Conclude the results of investigations about the phenomenon of climate change.
6 = Explain the application of technology to overcome climate change.
7 = Explain the implications of climate change to society and otherwise.

Based on the graph in Figure 2, the improvement of the ability of climate literacy for each indicator of students in the experimental class is higher than the control class.

The ability of climate literacy in the experimental class has improved after learning with the SETS vision, which is reviewed from climate literacy indicators. The first indicator that explains the concepts of climate science has increased by 0.72 with a high category. It is because during the SETS vision learning in the invitation phase, students are taught to identify the concept of the greenhouse effect of a climate change phenomenon. The teacher give problems related to climate change issues in the surrounding environment to students as science elements in the SETS vision. Students are focused and enthusiastic to the learning process because they are interested in problems and phenomenon that exist around the environment. As it is related to the statement of Ristina *et al.* (2019) that learning relate to environmental issues can make students more active in learning so as to develop students' scientific literacy. According to Miller and Sladek (2011), one of the characteristics of a climate literate person is communicates about climate and climate change in a meaningful way. It means that the person is aware to climate change issues and want to find solutions to prevent or overcome it. Activities in the invitation phase can develop students' climate literacy in terms of explaining and identifying environmental issues.

The second indicator that distinguish scientific and non-scientific questions from articles on the phenomenon of climate change has the lowest improvement of 0.56 with the medium category. It is because some students find it difficult to distinguish between scientific and non-scientific questions in the articles on climate change phenomenon which has given. It is also influenced by the low of reading literacy habit in the environment of students so they are difficulties for answering questions, which are require to read science articles that presented first. As it is also stated in the research conducted by Permanasari (2016) that the low ability of students in reading and interpreting text science becomes an obstacle in developing students' scientific literacy. According to PISA 2015 (OECD, 2017: 43), to understand and answer written questions about scientific literacy, students are require to read the text well so that reading literacy is needed.

The third indicator is plan how to explore scientific questions has the highest improvement of 0.74 with a high category. It is because students are taught to design an investigation of environmental problems through practical activities in learning. The SETS vision learning in the exploration phase is ask students do outdoors practical activities to interact with the surrounding environment as an environmental element in the SETS vision. This practical activity process that the influence of plants on the concentration of greenhouse gases in the atmosphere through tools that have been made by each group. Students are very enthusiastic in practicing. It is because the practical learning held in outdoor and related to the environment so that it becomes a special attraction for students to learn about global warming. In addition, because students rarely do practical learning activities, especially in physics. Climate literacy can be developed through practical activities because students learn based on scientific methods and are supported by student worksheets, which arranged based on SETS elements and indicators of climate literacy. As it is also stated in the research by Hernawati *et al.* (2019) that practical activities have a significant influence on the ability of scientific literacy.

The fourth indicator that is transform data and analyze the results of investigations which has increased by 0.66 with the medium category. It is because students are not accustomed to transform data into diagrams or graphs. Some students are not quite right in making graphics. As it is related with research by Nurkaenah *et al.* (2019) that students are not accustomed to communicate data and images in the form of diagrams or tables although they get developed in scientific literacy. Beside of that, students are still lack of analytical skills. It because students only read the graphs that have been made and not give the reasons. The fifth indicator that is conclude the results of investigations has increased by 0.73 with a high category. The average of students are able to make conclusions from the data investigation. It is because in the SETS vision learning process in the solution phase, students are taught to conclude an experiment through practical activities and then communicate these results through presentations.

The sixth indicator that explain the application of technology to reduce climate change which has increased by 0.72 with a high category. It is because during the SETS vision learning process, students are very interested and enthusiastic when discussed and looked for the information about the application of technology to overcome climate change. As it is related to Supriyadi *et al.* (2019) that learning science using the SETS approach make students interested because they can understand the benefits of the knowledge learned. Activities in the application phase include technology elements in the SETS vision. The seventh indicator that explain the implications of climate change to society and the implications of the community to climate change has increased by 0.58 with the medium category. During the SETS vision learning in the concept strengthening phase, students have discussed the implications of climate change to society and otherwise, but on the learning outcomes of the improvement of climate literacy in the moderate

category. It is because some students have other perceptions to answering these questions. Some students just mention it and do not explain it with examples. These results can measure students' understanding of climate literacy in elements of society.

Based on the description, it conclude that the application of the SETS vision learning can develop students' climate literacy in the high category. It occures because during the learning process, students are involved in gaining knowledge through the SETS vision learning stages based on scientific methods. The SETS vision learning is integrated into the learning process, which includes identifying climate concepts which is an elements of science, carrying out environmental-based practical activities and discussing positive actions that can be taken to prevent climate change which are elements of environment, conducting discussion activities about technology that can prevent climate change which is an element of technology, and discusses the implications of climate change to society and the implications of society to climate change which is an element of society. The stages of learning are compatible with the achievements of the climate literacy indicators so that the SETS vision can encourage and shape students to have a better ability of climate literacy. It is related to the research by Nurkaenah *et al.* (2019), Ristina *et al*. (2019), Zahara and Atun (2018), Praja *et al.* (2015), which states that the SETS vision learning affects the scientific literacy of students and can improve science literacy in the medium category.

CONCLUSION

Based on the results of the research, it can conclude that the application of the SETS vision learning on global warming material can develop students' climate literacy which is seen from the significant improvement (n-gain) of the climate literacy test results. The improvement is indicated by the n-gain score of 0.70 with a high category. The improvement of climate literacy in the experimental class is higher than the control class which has the n-gain score of 0.44 with the medium category. Physics learning with SETS vision is compatible with the indicators of climate literacy so that it can develop the students' climate literacy in each indicator. The improvement of the ability of students'climate literacy can improve the awareness and concern of students about climate change that occurs in the surrounding environment. The implication of the results of this research is to provide opportunities for teachers to develop learning innovation by involving students' climate literacy ability on relevant content. Suggestions for further research is to increase the number of meetings so that students truly understand the content through the SETS vision learning.

REFERENCES

Atminiati, Eny, and Achmad Binadja. (2017). Keefektifan Pembelajaran Guided Note Taking Bervisi SETS Bermedia Chemo Edutainment. *Jurnal Inovasi Pendidikan Kimia, 11(2),* 1988-1996.

Azevedo, J. and Marques, M. (2017). Climate Literacy: A Systematic Review and Model Integration. *International Journal of Global Warming*, 1-17.

Borich, G. D. (1994). *Observation Skill for Effective Teaching*. New York: McMillan Publishing.

Festiyed and Yulkifli. (2013). Internalisasi Integrasi Karakter Religius Pada Materi Fisika. *Prosiding Seminar Pembelajaran Fisika*. November 2, 2013. *Universitas Negeri Padang*, 107-115.

Gunamantha, I. M. and Dantes, N. (2019). Climate Change Literacy of Elementary School Students in Buleleng District, Bali Province, Indonesia. *Journal of Physics: Conference Series (JPCS), 1254*, 1-12.

Hakee. (1999). *Analyzing Change/Gain Score*. Indiana Universitas : Bloominton.

Hariyono, E., *et al*. (2018a). Designing Geoscience Learning for Sustainable Development: A Professional Competency Assessment for Postgraduate Students in Science Education Program. *Jurnal Penelitian Fisika dan Aplikasinya (JPFA), 8(2),* 61-70.

Hariyono, E. and Liliasari, S. (2018b). The Characteristics of Volcanic Eruption in Indonesia. In Gemma Aiello. *Volcanoes - Geological and Geophysical Setting, Theoretical Aspects and Numerical Modeling, Applications to Industry and Their Impact on the Human Health* (pp 72-94). IntechOpen.

Hernawati, D., *et al*. (2019). Science Literacy Skills through The Experience of Project Activities with Assisted Local Potential Based Learning Materials. *Jurnal Pendidikan Biologi Indonesia (JPBI), 5(1),* 159-168.

Khasanah, Nur. (2015). SETS (*Science, Environmental, Technology and Society*) sebagai Pendekatan Pembelajaran IPA Modern pada Kurikulum 2013. *Prosiding Seminar Nasional Konservasi & Pemanfaatan Sumber Daya Alam, 1(1).* January 13, 2015. *Universitas Sebelas Maret*, 270-277.

Lapan. (2017). *Perubahan Iklim : Penyebab, Dampak, dan Antisipasi*. Bandung: Pusat Sains dan Teknologi

Atmosfer (PSTA) Lembaga Penerbangan dan Antariksa Nasional.

Loo, Y. Y., Billa, L., and Singh, A. (2015). Effect of Climate Change on Seasonal Monsoon in Asia and Its Impact on The Variability of Monsoon Rainfall in Southeast Asia. *Geoscience Frontiers, 6(6),* 817-823.

Miler, T., and Sladek, P. (2011). The Climate Literacy Challenge. *Procedia Social and Behavioral Sciences*, *12*, 150–156.

Nurkaenah, Isnaini, W., and Subali, B. (2019). Influence of SETS Science Learning Program Towards Scientific Literacy Improvement. *Journal of Primary Education*, *8(1),* 59 – 66.

Organization for Economic Cooperation and Development (OECD). (2017). PISA 2015 *Assessment and Analytical Framework: Science, Reading, Mathematic, Financial Literacy, and Collaborative Problem Solving.* Paris: OECD Publishing.

Permanasari, Anna. (2016). STEM Education: Inovasi dalam Pembelajaran Sains. *Prosiding Seminar Nasional Pendidikan Sains (SPNS) 2016. Universitas Sebelas Maret*, 23-34.

Poedjiadi, Anna. (2010). *Sains Teknologi Masyarakat (Model Pembelajaran Kontekstual Bermuatan NIlai).* Bandung: PT. Remaja Rosdakarya.

Praja, Suyatno, and Supardi. (2015). Penerapan Pendekatan *Science Environment Technology and Society* (SETS) untuk Meningkatkan Literasi Sains Siswa. *Prosiding Seminar Nasional Kimia*. *Universitas Negeri Surabaya*, 90-96.

Ratumanan, G. T. dan Laurens. (2011). *Evaluasi Hasil Belajar pada Tingkat Satuan Pendidikan*. Surabaya: Unesa University Press.

Ristina, H., Linuwih, S., and Nuswotati, M. (2019). SETS Learning Efficacy To Improve Students Science Literacy Skills. *Journal of Innovative Science Education, 8 (2),* 183-189.

Sugiyono. (2018). *Metode Penelitian Pendidikan: Pendekatan Kuantitatif Kualitatif dan R&D.* Bandung: Alfabeta.

Supriyadi, *et al*. (2019). Science Environment Technology and Society Approach Learning to Improve Natural Disaster Mitigation Literacy. *Journal of Physics: Conference Series (JPCS) 1387*, 1-15.

Widiantini, Ni Nyoman Ayu Sri, Made, P., and Wayan I. W. (2017). Model Pembelajaran SETS (*Science, Environment, Technology, Society*) Berbantu Virtual Lab Berpengaruh Terhadap Kompetensi Pengetahuan IPA. *Journal of Education Technology*, *1(2),* 141-148.

World Economic Forum. (2020). *The Global Risk 2020 15th Edition*. Switzerland: World Economic Forum.

Zahara, H. S., and Atun, Sri. (2018). Effect of Science-Technology-Society Approach on Senior High School Students' Scientific Literacy and Social Skills. *Journal of Turkish Science Education*, *15(2),* 30-38.