Jurnal Penelitian dan Pembelajaran IPA JPPI
Vol. 5, No. 2, 2019, p. 155-168 p-ISSN 2477-1422 e-ISSN 2477-2038

# Fun Science Teaching Materials on the Energy Transformation to Promote Students' Scientific Literacy

**(**Received 17 October 2018; Revised 29 November 2019; Accepted 29 November 2019)

**Indarini Dwi Pursitasari**[1*], **Eka Suhardi**[2], **Tuti Putikah**[3]

[1]Science Education Program, Program Pascasarjana,
Universitas Pakuan, Bogor, Indonesia
Corresponding Author: *indarini.dp@unpak.ac.id

[2]Education Management Program, Program Pascasarjana,
Universitas Pakuan, Bogor, Indonesia
[3]SMP Negeri 3 Takokak, Cianjur, Indonesia

**DOI: 10.30870/jppi.v5i2.4008**

## Abstract

This study aims to develop fun science teaching material on the energy transformation to promote scientific literacy of junior high school students. The research is a four-D design of Research and Development. The validity of designed teaching materials had been determined by experts and science teachers. Scientific literacy achievements and student's responds were obtained using scientific literacy test and questionnaire on 95 students. Data analysis was carried out in a quantitative descriptive. The result of this study shows the fun science design contains the concepts of energy transformation that are presented contextually in form of comics strip and science songs, the validity score from experts and teachers were 87.5% and 93.5% respectively, N-gain of 62%, and most of students agree with the use of fun science teaching materials. Thus, fun science teaching material can be used in science learning to promote scientific literacy.

Keywords: Scientific Literacy, Teaching Material, Fun Science

## INTRODUCTION

As a matter of fact, science learning contains of three aspects, namely content, process and context (Mariana & Alit, 2010). The content science aspect is referred to hierarchy of knowledge, the concept's principal, theory and theoretical reference. The content's aspect is a main concept of science which is used to understand the natural phenomena and their changes. The process' aspects are all skills of science processes on the practical-life. Science teaching-learning must be accommodated by the three aspects above so as the main purpose of science learning activity can support students to perform science literacy.

Scientific literacy covers understanding of the nature and role of science in the public and personal life (National Research Council, 1996). *Organization for Economic Cooperation and Development* (OECD, 2014) defines that scientific literacy is the ability to build reliable human resources and able to implement the knowledge and also information in practical-life. Students with good scientific literacy are able to asking questions, finding answer on their curiosities, and also are able to describe, to explain, and to predict natural phenomena. Science and technology problems can be overcome by upgrading scientific literacy (Turiman et al., 2011). Scientific literacy emphasizes to several aspect, for instance science, technology, society, and environment (STSE), problem solving and decision-making skill, knowledge and science understanding, and scientific attitude.

In fact, scientific literacy ability of Indonesian students is still bellowing the standard. The latest rating research from *Program for International Student Assessment* (PISA) studied in 2015, Indonesia got 403 scores that was below the average score 493, so Indonesia is in rank $67^{th}$ from 72 countries participated on the research (OECD, 2016). Research result from Rubini et al. (2016) stated that scientific literacy of students in Bogor city was still showing unsatisfying one. The average of all scientific aspect was 30% and the average scientific literacy aspect of content, process, and science attitude were 29%, 30%, and 31% respectively.

The efforts to improve scientific literacy can be done by using learning designs and methods such as discovery and problem-based learning (Ardianto & Rubini, 2016), contextual learning with collaborative strategic (Rubini & Permanasari, 2014 and Oluwatelure, 2010), laboratory-based discovery learning (Rubini et al., 2017), and

inquiry-based learning (Sikas, 2017; Mc. Cright, 2012, and Ural, 2016). The enhancement of scientific literacy was also been done by using several approaches and learning strategic such as scientific approach (Hume & Coll, 2010; Genç, 2015), integrated-science learning approach (Webb, 2009 and Ardianto & Rubini, 2016), argumentation strategic (Washburn & Cavagnetto, 2013), and socio scientific issue (Rubini et al., 2019).

Other factor influencing the ability of student's scientific literacy is teaching material. Teaching material could facilitate students to learn a basic competency in orderly and systematically, so the students are able to manage the accumulation of all competencies as a whole and integrated. But teaching material being used by student on one of junior high school in West Java Province was not containing literacy aspect proportionally. The average of showing up of science as the root of knowledge, science as the way of surveying, science as the way of thinking were 76.02%, 49.98%, and 44.44% respectively. Moreover, the science that categorized as interaction among science, technology, and society were 35.42% (Ardianto & Pursitasari, 2017). This outcome figures out that the available book was still mostly on the knowledge content. Science book was not facilitating student to be accustomed of performing research and thinking, and also has not integrating science, technology and society yet.

Interviewing some science teachers of junior high school at one of district in Indonesia was indicating that science textbooks were monotonous, put more emphasis on concept and theory, presentation of material is unattractive and boring, students also got less involved in learning process. This condition will give an impact that student's scientific literacy ability is not satisfied with the average of 66.9%. Besides that, the observation showed that several students are still littering. The Students are not implementing the knowledge on science in their practical-life yet. Whereas student will be easy to understand and comprehend science whenever the presentation of teaching material is accordingly the logic that related to daily life (Holbrook, 2005).

Based on the following problem, it is needed to develop fun science teaching material, where its presentation material to be linked with the real world situation, encouraging students to connect relationship between their knowledge of science with practical-life, and make students happy to study science as well as expected the improvement of the ability of the students' scientific literacy.

## METHOD

The method that used on this research was Research and Development. The design development used on this research was 4-D design that consists of define, design, develop, and disseminate. This research is confined to develop stage.

The research activity was begun from define stage that was conducting requirement analysis, curriculum analysis, materials, indicator for basic competency and science literacy, science phenomenon that associated with materials. The second step was design stage that was arranging learning material for the topic of shape and energy change by adding comic strip on every chapter, song, and science activities so it became fun activities. Design of visual comic was using *Adobe Photoshop* program and *GIMP Sai Paint-tool.* Some steps in designing learning materials for fun science were determining topic, developing comic strip, and instrument development. The draft teaching materials produced was then continued to developing stage. Developing stage needed validation from four lecturers as material and multimedia experts and two science teachers as users. The experts used eligibility standards to recommend the teaching material by adding the content of scientific literacy in that instrument. Revision of teaching materials draft would be made based on the input got from experts and teachers, and then implementing test of student's reading literacy. The third step was implementing this learning material to be studied by 95 students. Scientific literacy test was applied to the students before and after they read the book. The design on this step is using One Group Pretest-Posttest design *(*Fraenkell & Wallen, 2009).

$O_1$ —— X —— $O_2$

Figure 1. One Group Pretest-Posttest design

Beside the test, filling out questionnaire was also implemented to describe student's opinion to the developing learning material. The data of student's ability on the science literacy was processed descriptively and counted in order to see its escalation or N-gain (Hake, 1999), while questionnaire data was processed descriptively and quantitatively.

## RESULTS AND DISCUSSION

Teaching material is one of learning media who play role in supporting student's needs at school. The result of research into development of fun science learning material should be started with the needs analysis.

**Needs Analysis on Fun Science Teaching Material**

The needs analysis was implemented by interviewing science teachers at one of Junior High School at one of region in Indonesia concerning the content of science textbook. In this case, three textbooks were selected. Those books are from different publisher and already passed from book center sensor, and the most use books in that region. These books that would be analyzed named as book A, B, and C.

The analyzing result showed that the three books were still presenting material separately. This finding was in line with Asrizal et al. (2018) and Rahmania et al. (2017). They found out that learning material in the science textbooks were disintegrated into sub-discipline of physic, biology, and chemistry. None of the three books were containing literacy aspect in the proportional way. The result was also showing that learning material on each book was more emphasized on science whereas it lacks of technology aspect and people. Moreover, there was a book containing only 31.25% of science and its relation to the technology and people.

Based on the analyzing of curriculum, material, and indicator, so the topic chosen was energy transformation. This topic may integrate each other, from biology content, chemistry content, physic content into one unit of science context. The context of science is vehicle for students to learn the material books. Gartwaite et al. (2014) have analyzed students' scientific literacy in the contexts of lighting and health. The results of his research show students can explain multiple levels simultaneously, both within and between contexts.

**Design and Development of Fun Science Teaching Material.**

This fun science learning material using theme of energy transformation as a teaching material may be used to fulfill scientific literacy and got a lot of fun through practical-life. Fun teaching materials connecting problem with practical life is improving student's scientific literacy (Fibonacci & Sudarmin, 2014). The content given is in a comic strip in every sub-title and science songs making the students to learning in a fun way as well as encouraging them to interconnecting between the knowledge given with their practical life. There would be 15 icons in the content. Figure 2 is the icons at sub-title and icons title design presented on science song.

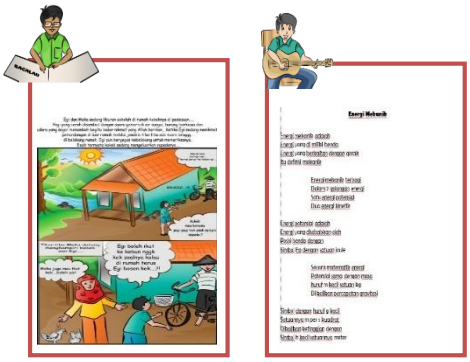

Figure 2. The Characteristic of Context-based Fun Science Teaching Materials

Fun-science teaching material is also containing scientific literacy domain that refers to PISA 2012 work frame (OECD 2014), that is competency, context, and contain domain. Competency domain consists of three indicators that has been integrated into teaching materials to identify science issue, explaining phenomenon scientifically, and using scientific evidence, and moreover the indicators of domain context in teaching materials where the life situation involved with science and technology. Contain domain indicators in teaching material are in the form of knowledge that is about natural and the science itself. Scientific literacy indicator that existed in teaching material is explained on Table 1.

Table 1. The Indicator of Scientific Literacy in Teaching Materials

| No. | Indicator of Science Literacy PISA(2015) Framework | | | Location on Learning Material |
|---|---|---|---|---|
| | Context | Contain | Competency | |
| 1 | Local | Shape, source, and energy change | Identifying keywords for scientific information | In the picture story titled '*Si Manis Sumber Energi'* (The Sweet of Energy Source) on the icon '*Bacalah Aku!'* (Read Me!), (page: 5) |
| 2 | Local | Shape, source, and energy change | Describing or interpret phenomenon and predicting change | During observing activity and analyzing shape and energy change on icon '*Ayo Cari Tahu!'* (Let's find out!), (page: 10) |
| 3 | Global | Source of Energy | Interpreting scientific evidence and draw a conclusion | During observing of utilizing energy source on icon *'Ayo Diskusikan!'* (Let's discuss!), (page: 11) |
| 4 | Global | Renewable Energy | Interpreting scientific evidence and draw a conclusion | During observing and analyzing of using renewable energy on icon '*Kamu Harus Tahu*!' (You should know!), (page: 12) |
| 5 | Local | Mechanical Energy | Identifying keywords for scientific information | During identify various kinds of mechanical energy on icon 'Ayo Dendangkan!' (Let's tune!), (page: 13) |
| 6 | Local | Various kinds of Mechanical Energy | Identifying keywords from data and scientific evidence | On the icon '*Ayo Berlatih!*' (Let's exercise!), (page: 13) |

| No. | Indicator of Science Literacy PISA(2015) Framework | | | Location on Learning Material |
|---|---|---|---|---|
| | Context | Contain | Competency | |
| 7 | Global | Energy Changed | Describing or interpret phenomenon and predicting change | On the icon *'Ayo Berlatih!'* (Let's exercise!), (page: 17) |
| 8 | Local | Alternative Energy | Recognizing the features of scientific research | On the icon *'Ayo Bereksperimen!'* (Let's experiments!) and in the icon *'Ayo Sajikan!'* (Let's presented!), (page: 20) |
| 9 | Local | Effort and Power | Identifying keywords for scientific information | In a comic with the title of *'Cucuku Hebat!'* (My granddaughter is great!) on the icon '*Bacalah Aku!'* (Read Me!), *(*page: 24) |
| 10 | Local | Effort and Power | Describing or interpreting phenomenon and predicting changes | During observing and analyzing kinds of effort and power on icon 'Ayo Cari Tahu!' (Let's find out), (page: 28) |
| 11 | Local | Example of power in everyday life | Interpreting scientific evidence and draw a conclusion | During observing the example of power in everyday life on icon 'Ayo Diskusikan!' (Let's discuss), (page: 29) |
| 12 | Local | Understandin g of Effort and Power | Identifying keywords for scientific information | On identification activity to understand effort and power on icon 'Ayo Dendangkan!' (Let's tune), (page: 3) |
| 13 | Local | Effort and Power | Identifying keywords from data and scientific evidence | On the icon 'Ayo Berlatih!' (Let's exercise!), (page: 32) |
| 14 | Local | Solar Energy | Recognizing the nature of scientific investigation | On the icon 'Ayo Bereksperimen!' and in the icon 'Ayo Sajikan!' (Let's presentation), (page: 36 and 37) |
| 15 | Local | Shape and Energy Change | Describing or interpreting phenomenon and predicting changes | On the icon 'Ayo Selesaikan!' (Let's finish!), (page: 41) |

Table 1 indicates that fun science teaching material facilitated students to learn science in a fun way. Fun learning supported students learning in a fun way, therefore the students gained a meaningful learning (Trinova, 2012). Fun-science teaching materials on comics or picture-designed and song are able to represent the lesson to be an effective. Stieff (2011) stated that the

representation use is able to make the students understanding the lesson easily as well as supporting students to use science logical thinking. The learning materials developed contains of discovery-based learning that leading the students to take a challenge to learn science in order to understanding it holistically. Kelly & Finlayson (2008) recommended that practice leads students to develop skills, understanding the concepts and the process of experiment well.

The validity test was taken on fun science learning material by four lecturers to see whether it covers context component, literacy component, representation component, and graphic-design requirement. The result can be seen on Table 2.

According to the validation taken by the experts, it is showed that fun science learning material's N-gain is 3.5 (87.5%), as it is categorized as valid. The inputs from the experts were that the mapping of concept on each sub-title and the basic-competency should be added by the question-design before the practice. They also recommended to putting the flowchart of concepts. Table 3 indicates their recommendation.

After collecting the experts' inputs, the teachers took an evaluation on fun science learning material to see that it is eligible and appropriate or not for the junior high students of 7$^{th}$ class. It is seen on Table 4.

Tabel 2. The Result of Eligibility Test on Fun Science Teaching Materials

| Component | Validator's Evaluation in Average | | | | Average |
|---|---|---|---|---|---|
| | VAL-01 | VAL-02 | VAL-03 | VAL-04 | |
| Content Eligibility | 3.9 | 3.9 | 3.3 | 2,1 | 3.3 |
| Language | 4.0 | 4.0 | 3.4 | 2,6 | 3.5 |
| Presentation | 4.0 | 4.0 | 3.5 | 2,8 | 3.6 |
| Graphic-Design | 4.0 | 4.0 | 3.0 | 3.0 | 3.5 |
| Scientific Literacy | 3.9 | 3.9 | 3.2 | 3.1 | 3.5 |
| Average and Criteria = 3.5 (87.5%) : Valid | | | | | |

Table 4 show the average of science teachers' evaluation pertaining developed fun science learning materials is 3.74 (93.5%) as it is valid. The teachers were also giving inputs that the competency test is needed. Based on the result analysis pertaining fun science teaching material, it is concluded that fun-science teaching material is eligible to be used as one of learning source for the junior high students.

Table 3. Recommendation and Revisions of Teaching Materials.

| Expert | Recommendation | Revision of Step 1 |
|---|---|---|
| The Expert | 1. Adding concept mapping on each sub-title and basic-competency. | 1. The concept mapping on each sub-title and basic-competency had been added seen in Picture 4.2 |

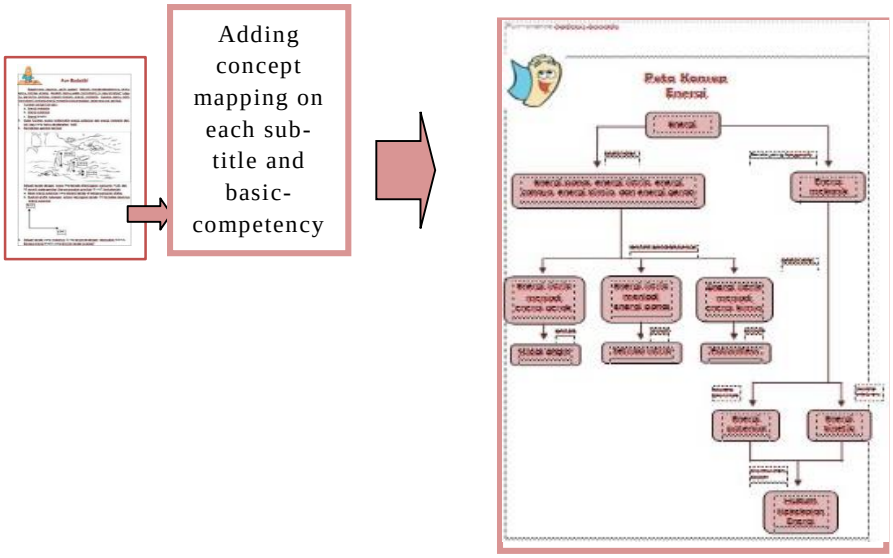


Table 4. The Result of Teacher's Evaluation

| Component | Validator's Score Average | | Average |
|---|---|---|---|
| | Teacher 1 | Teacher 2 | |
| Content Eligibility | 3.6 | 3.6 | 3.6 |
| Language Literacy | 3.8 | 4.0 | 3.9 |
| Presentation | 3.5 | 4.0 | 3.8 |
| Graphic Design | 3.7 | 3.5 | 3.6 |
| Scientific Literacy | 3.6 | 3.9 | 3.8 |
| Average and Criteria = 3.74 (93.5%): Valid | | | |

**Using of Teaching Materials for Students' Scientific Literacy Improvement**

The design developed from this research is context-based fun science teaching materials entitled energy transformation presented in special icons. One of the special icons to read is *"Bacalah Aku!"* (Read Me). It is contained of comics that making the students are interested to learn as well as supporting students to understanding the lesson in an easy way and in a fun way. The students took a pre-test before using fun science teaching material. The students took also the post-test after using it. The two tests were taken in order to see the impact of the teaching material toward the student's scientific literacy. The result of scientific literacy test is showed on Table 5.

Table 5. The Result of Students' Scientific Literacy

| Description | Scientific Literacy | |
|---|---|---|
| | Pre-test | Post-test |
| Highest Score | 76 | 96 |
| Lowest Score | 44 | 68 |
| Average Score | 58.3 | 84.1 |
| Standard Deviation | 8.0 | 7.8 |
| Variance | 64.0 | 60.8 |
| Average N-gain | 62% | |

Table 5 indicated that scientific literacy outcome on the post-test is higher than it was on the pre-test. The outcome improvement is not only in high-score but also in low-score and average score. It is proved that there is an improvement on student's scientific literacy after reading fun science books with N-gain 62% in average. Fibonacci and Sudarmin (2014) also recommended that discovery-based learning guided by Fun-Chem effectively improving students' scientific literacy. The use of teaching materials can also improve student's academic abilities (Olayinka, 2016). The result similar with the study of Holbrook (2005) that the students will easily understand comprehend science when using teaching materials that accordance with logic and relate to daily life. It is also explained that someone has to perform the scientific literacy capability to adapt himself in global revolution as well as in his nation grow (Genç 2015). In the digital age, scientific literacy can be developed through computer applications, software tools, and environments that were designed to support processes of collaborative inquiry learning (Okaido, 2013) and integration of information and communication technology (Adolpus & Arokoyu, 2012).

**The Response of Students toward Fun Science Teaching Material.**

After learning with fun science teaching materials on the topic of energy transformation, the students showed a positive response. It is showed on Table 6.

Table 6. The Percentage of Student's Response on Fun Science Learning Material

| No | Statement | % Students positive response |
|---|---|---|
| 1. | Interested on icons. | 88.7 |
| 2. | Learning using contextual-based comics. | 88.4 |
| 3. | Comics support to understand the content. | 87.6 |
| 4. | Language is easy to understand. | 80.3 |
| 5. | Science songs helping to understand the content. | 91.1 |
| 6. | Contextual-based fun science learning materials enable to learn independently. | 77.4 |
| 7. | Contexts-based fun science learning materials change learning style | 76.8 |
| 8. | The composition of picture and narration in comics is accordingly the needs | 77,9 |
| 9. | I enjoy using fun science learning material | 82.1 |
| | Average | 83.4 |

Based on the Table 6, it can be seen that the learning material gained positive response from the students that have readability average is 83.4%, so the readability of teaching material is good category. The highest response is "Some

parts of the content delivered by science songs in variety ways helping me to understand the content". This shows the teaching material with song can make student happy and make to easy learn energy transformation. So far, the lowest response is "Contexts-based fun science learning materials changes my learning style". This is due to students have a different learning style that is visual, auditory, and kinesthetic. Students who recognize their learning style, they will easily integrate it into the learning process, so learning process become more fun, faster, and more effective (Awla, 2014).

## CONCLUSION

According to the result of the research and development that had been taken, fun science teaching materials for the energy transformation was able to promote scientific literacy of junior high school students. It also proved that the fun science teaching materials are valid criteria of content, language literacy, graphic design, presentation, and science literacy aspects. The characteristic of fun science learning material are; (1) science materials are contextually connected with daily-life, (2) presenting 15 icons with pictures, science songs, investigating, and variety of assessment, (3) providing scientific literacy domain, (4) The variety of colorful layout is accordingly match with the students' characteristic. Therefore, it can be concluded that pertaining the use of fun science teaching material, the students' scientific literacy was promoted with N-gain of 62% which it is categorized as medium level and the most of students agree with the use of fun science teaching materials in classroom.

## ACKNOWLEDGEMENT

A gratitude to the Directorate of Research and Community Service (DRPM) Director General of Research and Development Strengthening the Ministry of Research, Technology and Higher Education who has provided on decree number 7/E/KT/2019.

## REFERENCES

Adolphus, T, & Arokoyu, A.A 2012, 'Improving Scientific Literacy among Secondary School Students through Integration of Information and Communication Technology', *ARPN Journal of Science and Technology*, vol. 2, no. 5, pp. 444-8.

Ardianto, D., & Rubini, B 2016, 'Comparison of Students' Scientific Literacy In Integrated Science Learning Through Model Of Guided Discovery And Problem Based Learning', *Jurnal Pendidikan IPA Indonesia*, vol. 5, no. 1, pp. 31-7

Ardianto, D. & Rubini, B 2016, 'Literasi sains dan Aktivitas Siswa pada Pembelajaran IPA Terpadu tipe Shared, *Unnes Science Education Journal*, vol. 5, no. 1, pp. 1167-74

Ardianto, D. & Pursitasari, I. D 2017, 'Do middle School Science Textbook Enclose an Entity of Science Literacy?', *Journal of Humanities and Social Studies*, vol. 1, no. 1, pp. 24-7

Asrizal, Amran, A., Ananda, A., Festiyed, & Khairani 2018, 'Effectiveness of integrated science instructional material on pressure in daily life theme to improve digital age literacy of students', *Journal of Physics: Conf. Series.* no. 1006, pp. 012031

Awla, H. A 2014, 'Learning Styles and Their Relation to Teaching Styles. *International Journal of Language and Linguistics*, vol. 2, no. 3, pp. 241-5

Fibonacci, A., & Sudarmin. 2014, 'Development Fun-Chem Learning Materials Integrated Socio-Science Issues to Increase Students Scientific Literacy', *International Journal of Science and Research*, vol. 3, no. 11, pp. 708-13

Fraenkel, J. R. & Wallen, N. C 2009, *How to Design and Evaluate Research in Education*. 7th edition, Mc-Graw Hill, Boston

Garthwaite, K., France, B., and Ward, G 2014, 'The Compexity of Scientific Literacy: The Development and use a data analysis matrix', *International Journal of Science Education*, vol. 36, no. 10, pp. 1568-87.

Genç, M 2015, 'The Effect of Scientific Studies on Students' Scientific Literacy and Attitude, *Journal of Faculty of Education*, vol. 34, no. 1, pp. 141-52

Hake, R.R 1999, '*Analyzing Change/Gain Score. USA: American Educational Research Association's Division D, Measurement and Research Methodology*', viewed 10 June 2019, http://physics.indiana.edu/~sdi/Analyzing Change-Gain.pdf.

Hoolbrook, J 2005, 'Making Chemistry Teaching Relevant', *Chemical Education International*, vol. 6, no. 1, pp. 1-12.

Hume, A. & Coll, R. 2010, 'Authentic student inquiry: the mismatch between the intended curriculum and the student-experienced curriculum', *Research in Science & Technological Education*, vol. 28, no. 1, pp. 43–62

Kelly, O. & Finlayson, O 2008, 'A Hurdle Too High? Students' Experience of a PBL Laboratory Module', *Chemistry Education Research and Practice,* vol.10, pp. 42–52.

Mariana & Alit, I.M 2010, *Science Classroom Supervision: Developing Instrument for Improving Teaching and Learning Process*. P4TK IPA, Bandung.

Mc. Cright, A.M 2012. Enhancing students' scientific and quantitative literacies through an inquiry-based learning project on climate change, *Journal of the Scholarship of Teaching and Learning*, vol. 12, no. 4, pp. 86–102.

National Research Council. 1996. *National Science Education Standards* . The National Academies Press, Washington DC.

OECD. 2014. *PISA 2012 Results in Focus What 15-Year-Olds Know and What They Can do With What They Know*, Paris: OECD Publishing.

OECD. 2016. *Assessing Scientific, Reading and Mathematical Literacy A Framework forPISA 2015*. Paris: OECD Publishing.

Okaido, A 2013, 'Scientific Literacy In The Digital Age: Tools, Environments And Resources for Co-Inquiry', *European Scientific Journal*, vol. 4, pp. 263-274

Olayinka, A. R. B 2016, 'Effects of Instructional Materials on Secondary Schools Students' Academic Achievement in Social Studies in Ekiti State, Nigeria', *World Journal of Education, v*ol. 6, no. 1, pp. 32-39

Oluwatelure. A 2010, Classroom Learning environments As A Correlate Of Scientific Literacy. *Journal of College Teaching & Learning*, vol. 7, no. 6, pp. 1-10

Rahmania, Fitriani, A., & Kaniawati, I 2017, 'Role of Integrated Sciences Teaching Materials on Pressure Topic to Improve Student's Critical Thinking Skills in Junior', *Asian Journal of Education and e-Learning, v*ol, 5. no. 2, pp. 82-85.

Rubini, B. & Permanasari, A 2014, 'The Development of Contextual Model with Collaborative Strategy in Basic Science Course to Enhance Students' Scientific Literacy', *Journal of Education and Practice*, vol.5, no.6, pp.52-8.

Rubini, B., Ardianto, D., Pursitasari, I.D., & Permana, I 2016, 'Identify Scientific Literacy from the Science Teachers', *Jurnal Pendidikan IPA Indonesia*, vol. 5, no. 2, pp. 299-303

Rubini, B., Pursitasari, I. D., Ardianto, D. & Nugraha, N 2017, 'Improving Students'scientific Literacy on Environmental Pollution Through Laboratory-Based Learning', *Jurnal Pengajaran MIPA*, vol. 22, no. 2, pp. 1-7.

Rubini, B., Ardianto, D., Setyaningsih, S., & Sariningrum, A 2019, 'Using Socio-scientific Issues in Problem Based Learning to Enhance Science Literacy', *Journal of Physics: Conference Series.* vol. 1233, pp. 012073

Sikas, N 2017, 'Enhancing Scientific Literacy through Implementation of Inquiry-Based Science Education (IBSE) in Malaysia Science Curriculum', *International Journal of Academic Research in Business and Social Sciences*, vol. 7, no. 2, pp. 769-77

Stieff, M 2011, 'Improving Representational Competence using Molecular Simulations Embedded in Inquiry Activities' *Journal of Research in Science Teaching*, vol. 48, no. 10, pp. 1137-58.

Trinova, Z 2012, 'Hakikat Belajar dan Bermain Menyenangkan bagi Peserta Didik', *Jurnal Al-Ta'lim*, vol 1, no. 3, pp. 209-15

Turiman, P., Omar, J., Daud, A.M., & Osman, K 2011, 'Fostering the 21st Century Skills through Scientific Literacy and Science Process Skills', *Procedia - Social and Behavioral Sciences*, vol. 59, pp. 110–16.

Ural, L. 2016, 'The Effect of Guided-Inquiry Laboratory Experiments on Science Education Students' Chemistry Laboratory Attitudes, Anxiety and Achievement. *Journal of Education and Training Studies*, vol. 4, no. 4, pp. 217-27

Washburn, E., & Cavagnetto, 2013, Using Argument as a Tool for Integrating Science and Literacy. *The Reading Teacher*, vol. 67, no. 2, pp. 127-36

Webb, N. M., 2009. The teacher's role in promoting collaborative dialogue in the classroom. *British Journal of Educational Psychology*, vol. 79, pp. 1–28