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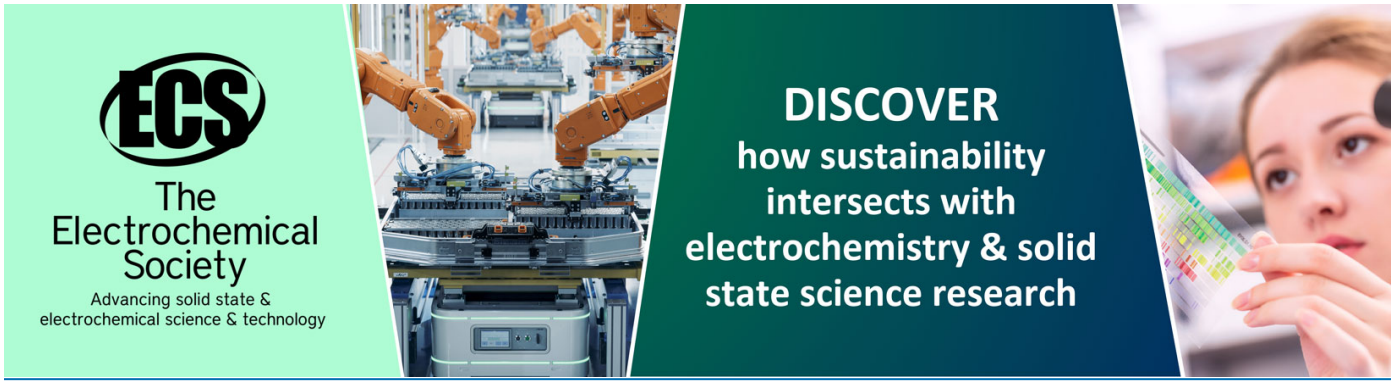

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Developing of physics teaching material based on scientific literacy

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Abstract. Physics teaching materials for a junior high school in Banjarmasin have not yet contained the criteria for scientific literacy component. Therefore, a development is carried out to produce physics learning materials based science literacy based on validity, effectiveness, practicality, achievement of scientific process skills, and attainment of student attitudes. The type of research is research and development using ADDIE model. The instruments used are learning materials validation sheets, lesson plan observation sheets, learning outcome test, science process skill observation sheets and the attitude observation sheet. The subjects of the try out are 29 students of the seventh grade SMPN 9 Banjarmasin. The result shows that the validity of teaching materials is categorized as valid, the practicality is categorized as highly practical, the effectiveness is categorized as moderate, the achievement of the scientific process skills is categorized as very good and the attainment of student attitudes is categorized as good. Based on these results, it can be concluded that this physics teaching material based on science literacy are feasible to use in learning process.

1. Introduction

One way to improve the quality of human resources in the 21st century which is marked by the rapid development of Science and Technology is through education. According to Law no. 20 Year 2003 of National Education System, education is a conscious and planned effort to create learning atmosphere and learning process in order that learners actively develop their potential to have spiritual power of religion, self-control, personality, intelligence, noble character, and skills needed by themselves, society, nation and state. Skills that must be mastered by students in the 21st century are reading, writing, describing, and understanding natural phenomena that exist around. Such skills can be trained in literacy. One form of literacy is scientific literacy. Scientific literacy can help students in the learning process so that learning materials can be applied to natural phenomena that exist on them. The results of research conducted by the Program for International Student Assessment (PISA) in 2015 showed that scientific literacy skill of Indonesian students are still relatively low [1]. The average achievement scores of Indonesian students for science, reading, and mathematics are ranked 62, 61, and 63 of 69 countries evaluated. These ratings and average to score do not differ greatly from previous PISA tests results and surveys in 2012 where Indonesia categorized in the low material mastery group.

Scientific literacy according to PISA is characterized by four aspects: context, knowledge, competence, and attitude of science [2]. The scientific literacy is not only fluent in interpreting science but also in applying science in everyday life [3]. The students' scientific literacy needs to be developed

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because it can improve: 1) knowledge and investigation of natural science, 2) vocabulary and written vocabulary necessary to communicate, 3) the relationship between science, technology and society [4]. The scientific literacy is very important for students to prepare their life in the current era of globalization, taking into account of environmental, health, economic, and other issues that occur in modern society [5,6].

Based on the results of interviews that has been done with science teacher in SMP Negeri 9 Banjarmasin, teaching materials used in the learning process come from printed books of a particular publisher. Based on the results of analysis on teaching materials used, the teaching materials do not meet the scientific literacy components required by PISA which are aspects of context, knowledge, competence, and attitude of science. This causes the students' scientific literacy does not develop optimally.

One of the efforts to overcome this problem is by developing scientific literacy based teaching materials that are arranged mathematically in accordance with the making of teaching materials that can build students' scientific literacy. The teaching materials created by teachers can help students learn independently [7]. The use of scientific literacy based teaching materials can increase the students' scientific literacy in learning [8]. The advantages of scientific literacy based learning are students can have a high curiosity and play an active role in the learning process. The use of teaching materials that are based on the learning objectives related to daily life, make students encouraged and active to read and learn inside and outside the hours of study [9].

The suitable material for scientific literacy based learning is a material related to everyday life [3]. Therefore, researchers chose dynamic electrical materials in the class IX of SMP. The application of Inquiry Discovery Learning (IDL) model can increase students' scientific literacy [6]. The learning model in inquiry groups to train students' process skills and academic problem solving is a guided IDL model [10]. In order to improve student learning outcomes, students can use instructional model guided by the teacher [11].

Based on the description above, the researchers conducted a study that developed physics teaching materials based on scientific literacy on dynamic electrical materials for junior high school students. The purpose of this research is to produce physics teaching materials with appropriate scientific literacy based on validity, practicality, effectiveness, achievement of science process skills, and student attitudes. It is expected that the developed teaching materials can be used to train the scientific literacy of junior high school students.

2. Method

This development research uses Analysis, Design, Development, Implementation, and Evaluation (ADDIE) development model with five stages [12]. The first stage (Analysis) is to analyze student learning needs and expected competencies. The second stage (Design) is designing teaching materials in accordance with the procedure of teaching materials arrangement to build scientific literacy. The third stage (Development) is developing teaching materials including Lesson Planning, teaching materials, Student Worksheet and Result Outcome Test and validation by experts. The fourth stage (Implementation) is implementing teaching materials developed by conducting field trials. The fifth stage (Evaluation) is the evaluation to find out the level of students' achievement in the learning process.

The subjects of this study were 29 students of class IX A SMP Negeri 9 Banjarmasin. Selection of test subjects is using purposive sampling technique. The data collection instruments are validation sheet, observation sheet, and test.

Validation is done by three experts. The average value obtained from the validators is adjusted to the existing criteria [13]. The reliability of teaching materials was analyzed using the Alpha Cronbach equation and the reliability criteria adjusted to the instrument reliability criteria [14]. The practicality of teaching materials is measured using the observation sheets of the lesson plan implementation. The analysis of lesson plan implementation uses equations based on [15]. The results of the lesson plan implementation analysis is adjusted to the lesson plan implementation category [16]. The effectiveness of teaching materials is measured using the Learning Outcome Test; pretest and posttest, and calculated

by the normalized gain (N-gain) [17]. The students 'science process skills are measured by the observation sheets of students' science process skills. Assessment criteria for students' science process skill are based on [18]. Assessment of student attitude aspect is by using attitude assessment sheet. Criteria for assessing students' aspects are based on [19].

3. Result and Discussion

The teaching materials developed to include lesson plan, teaching materials, worksheet and learning outcome test. The resulting lesson plans are three for 3 meetings during the 6 hours lesson. Teaching materials generated in this study included standard competence, basic competence, dynamic electrical materials contained discourse to construct literacy, important notes, science radar, sample questions, technology products, material practice, summary, glossary and bibliography, three experiments and learning outcome test with a total of 9 questions ranging from C2 to C4. The product developed can be seen in figure 1.


MENGKONTRUKSI LITERASI SAINS

Bacalah dengan seksama fenomena listrik dibawah ini!

Gambar 1. PT PLN (persero)
Sumber: Detik Finance

PLN Siapkan Rp 168 M untuk Terangi 105 Desa di Kalsel-Kalteng

Banjarmasin - PT PLN (Persero) mengungkapkan ada sekitar 400 desa yang belum teraliri listrik di provinsi Kalimantan Selatan (Kalsel) dan Kalimantan Tengah (Kalteng). Di tiap desa terdapat 50-100 rumah tangga atau kurang lebih 200-400 orang penduduk, maka total ada sekitar 80.000-160.000 penduduk di kedua provinsi itu yang sampai hari ini belum mendapat listrik sejak Indonesia merdeka 71 tahun lalu. Agar para penduduk desa ini dapat menikmati listrik seperti halnya penduduk di kota-kota besar, PLN telah menyiapkan dana Rp 168 miliar untuk menerangi 56 desa di Kalsel dan 49 desa di Kalteng di 2017, total ada 105 desa. "Rencana PLN Wilayah Kalselteng ada 105 desa yang akan dilistriki melalui Program Listrik Desa tahun 2017. Anggaran yang telah disiapkan 168 miliar," kata General Manager PLN Kalselteng, Purnomo, saat ditemui di PLTU Pulang Pisau, Selasa (20/12/2016).

Figure 1. Product of the Development Result

3.1. Validity Result of Teaching Material

Validation was done by three experts. Validation of teaching materials included lesson plan, teaching materials, worksheet and learning outcome test. Table 1 shows the results of lesson plan validation. Lesson plan validation results are categorized as valid and the reliability is categorized as high. Based on the validation results, the developed lesson plan is valid to be used. This indicates that the lesson plan is developed based on aspects of the format, language and content adapted to the applicable curriculum. A lesson plan can be categorized as valid if it is created based on terms and criteria [20]. If an instrument

has high reliability, it indicates that the result of the assessment given by the validator is relatively similar, thus the instrument can be implemented in the learning activity [15].

Table 1. Validity of Lesson Plan

Assessment Aspect	Mean	Category
Format	3.13	Valid
Language	3.17	Valid
Content	3.20	Valid
Mean	3.21	Valid
Reliability	0.77	high

Table 2 shows the results of the teaching materials validation. The results of validation of teaching materials in average of two aspects; content and display both are categorized as good with high reliability. A product is said to be valid if it meets the validation criteria where the average percentage of each assessment of each validation indicator is not less than 70 [21]. The teaching material is valid if it already has a good description because it is in accordance with its structure [22].

Table 2. Validation Results of Teaching Materials

	Aspect	Score
Content	Format	3.13
	Language	3.17
	Content	3.20
Format	Consistency	3.11
	Format	3.33
	Attractiveness	3.25
	Font Size and Type	3.00
	Language	3.00
Validity		3.21 (valid)
Reliability		0.77 (high)

The result of validation of student worksheet is shown in table 3. The result of worksheet validation includes three aspects; content, graphic and language are categorized as valid with high reliability. This indicates that the worksheet is valid to be used. The making of worksheet must meet certain conditions, such as questions made in the worksheet must be in accordance with the objectives of learning and the formulation of questions in the worksheet should be written clearly to make students understand easily [23].

Table 3. Validation Result of the Worksheet

Assessment Aspect	**Mean**
Content	3.00
Graphic	3.11
Language	2.92
Validity	3.01 (valid)
Reliability	0.72 (high)

The validation result of student learning outcome test is shown in table 3. The result showed that the learning outcome test which covers the aspect of assessment of general construction and validity of item are categorized as valid and the reliability is very high. Problems made based on learning objectives are nine questions that have varied cognitive levels such as C2, C3 and C4. The question given to students are said to be valid if it is used to measure the ability of learners, it can measure the ability that should be measured [24].

Table 4 Validation Result of Learning Outcome Test

Assessment Aspect	**Mean**
General Construction	3.06
Item Validity	3.07
Validity	3.06 (valid)
Reliability	0.87 (high)

3.2. Practicality of Teaching Materials

The practicality of teaching materials was measured through the implementation of lesson plan to use the lesson plan implementation observation sheet. Table 5 shows the practicality of teaching materials. The practicality of teaching materials is categorized as highly practical. The developed learning tools obtain lesson plan implementation practicality result of very good criteria is because the worksheet is arranged in such a way systematically based on guidelines in making of worksheet components [25]. Easy or not the product developed not only seen from the explanation of experts but also others that will use the product.

Table 5. Practicality of Teaching Materials

Phase	Practicality of Teaching Material (%)		
	Meeting 1	Meeting 2	Meeting 3
Orienting students to academic problems	70.00	90.00	97.50
Planning experiment	77.50	87.50	90.00
Guiding students in experimenting	77.78	87.50	94.44
Guiding students to predicting/ abstraction	75.00	75.00	87.50
Guiding students to reflecting	75.00	91.67	83.33
Closing	75.00	91.67	83.33
Mean	75.05	87.23	89.35
Category	Highly practical	Highly practical	Highly practical

3.3. Effectiveness of teaching materials

The effectiveness of teaching materials was measured from the Learning Outcome Test. based on the calculation results obtained N-gain of 0.47. The effectiveness of teaching materials is categorized as moderate. The effectiveness of teaching materials developed to improve students' scientific literacy learning outcomes is characterized by the increase in learning outcomes of scientific literacy [26]. Effective science teachers know the best how to design and guide learning experiences, under certain conditions and constraints, to help different groups of students develop scientific knowledge and general knowledge [27]. The advantage of this scientific literacy based development is encouraging students to understand the nature of science [28]). Although the category is moderate, the acquisition of N-gain is below minimum criteria for school which is set at 70. This happens because the time of learning activity with IDL model is spent for practicum activity, while guiding the students to do problem solving exercise is less maximal. This cause the proportion of students' answers in C4 cognitive levels (analyzing) becomes low. The IDL model is too concerned with the formation of student attitudes and skills [29].

3.4. Achievement of scientific process skills

The achievement of students' scientific process skills was assessed by using the science process skill observation sheet. Table 6 shows the achievement of students' science process skills which include observing, questioning, experimenting, reasoning and communicating. Student science process skills achievement is categorized as very good. The process skills are required to acquire, apply concepts, and develop scientific theories and law principle [3]. The students' science process skills will be better if the students do group work in conducting experiments and the learners are active during the teaching and

learning process in order to make students' memory more optimal [30]. The students' science process skills increase during learning because students are required to learn actively through predicting, observing and explaining activities that create a student discussion [31].

Table 6. Students' Science Process Skills Achievement

Indicator	Percentage of Science Process Skills Achievement			
	Meeting 1	Meeting 2	Meeting 3	Mean (%)
Observing	75.00	83.33	91.67	83.33
Questioning	77.08	79.17	89.58	79.61
Experimenting	77.08	85.42	97.92	84.47
Reasoning	83.33	81.25	89.58	84.72
Communicating	68.75	83.33	91.67	81.25
Mean Percentage	73.45	82.50	92.08	82.68
Category	Good	very good	very good	very good

3.5. Achievement of Attitude

Aspects of student attitudes were measured through the attitude observation sheet. Student attitudinal indicators are assessed from discipline, cooperation and tolerance. Achievement of student attitudes can be seen in table 7. Aspect of student attitudes is categorized as good. This shows that by applying scientific literacy based module, students' attitudes develop very well. The development of attitude changes in students, one of the factors is caused by the addition of students' knowledge of the learning that is applied especially in the stage of concept development in learning [32].

Table 7. Achievement Result of Students' Attitude

Attitude	Mean
Discipline	3.27
Tolerance	3.28
Cooperation	3.21
Mean	3.25
Category	good

4. Conclusion

Based on the results of the development, it can be concluded that the scientific literacy based teaching materials on dynamic electrical materials for junior high school students are feasible to use in learning. This is supported by the validation result of teaching materials that categorized as valid, aspects of practicality of the teaching material is categorized as highly practical, the effectiveness of the students are moderate, the achievement of students' science process skills is categorized very good and the attainment of student attitudes is categorized as good.

References

[1] OECD 2016 *PISA 2015 Result In Focus (Paris OECD)*
[2] OECD 2007 *PISA 2006 Result In Focus (Paris OECD)*
[3] Toharudin U, Hendrawan S, Rustaman A 2011 *Membangun Literasi Sains Peserta Didik* (Bandung: Humaniora)
[4] Hernandez M, Ikpeze C, Irene K 2015 *Educ. Res. Int*. **4** 25.
[5] Sastradika D 2017 *J. Phys. Conf. Ser.* **12017**.
[6] Arifin L, Sunarti T 2017 *J. Penelit. Fis. Apl*.**7** 68.
[7] Astuti M, Hartini S, Mastuang M 2018 *Berk. Ilm. Pendidik. Fis.* **6**.
[8] Amril A 2017 *J. Eksakta Pendidik*. **1** 96.
[9] Haristy DR, Enawaty E, Lestari I 2013 *J. Pendidik. Pembelajaran* **2** 6.
[10] Anshari B, Zainuddin Z, Salam A. A 2017 *J. Ilm. Pendidik. Fis.* **1** 8.

[11] Astuti Y, Setiawan B 2013 *J. Pendidik. IPA Indones*. **2** 8.
[12] Sugiyono S 2016 *Metode Peneltitan Kuantitatif, Kualitatif, dan R&D* (Bandung: Alfabeta)
[13] Hartini S, Misbah M, Helda H, Dewantara D 2017 *AIP Conf. Proceeds.*
[14] Arikunto S 2013 *Dasar-dasar Evaluasi Pendidikan* (Jakarta: Bumi Aksara)
[15] Mursali S 2016 *J. Pendidik. Biol. Indones.* **1** 5.
[16] Siswanto J, Susantini E, Jatmiko B 2017 *J. Penelit. Pembelajaran Fis*. **7** 4.
[17] R. R. Hake 1998 *Am. J. Phys.* **66** 65.
[18] Widoyoko EP 2014 *Evaluasi Program Pembelajaraan Panduan Praktis bagi Pendidik dan Calon Pendidik* (Yogyakarta: Pustaka Pelajar)
[19] Widoyoko EP 2016 *Evaluasi Program Pembelajaran* (Yogyakarta: Pustaka Pelajar)
[20] Chodijah S, Fauzi A, Ratnawulan R 2012 *J. Penelit. Pembelajaran Fis.* **1** 2.
[21] Palupi EW, Yuwono I, Muksar M 2017 *J. Kaji Pembelajaran Mat.* **1** 10.
[22] Khairani S, Asrizal A, Amir H 2017 *Pillar. Phys. Educ.* **10** 153.
[23] Yasir M, Susantini EI 2013 *J. Bio. Edu.* **2** 77.
[24] Akbar S 2016 *Instrumen Perangkat Pembelajaran* (Bandung: PT Remaja Rosdakarya)
[25] Rifansyah M, Mastuang M, Salam A 2017 *Berk. Ilm. Pendidik. Fis.* **5** 286.
[26] Budiningsih TY, Rusilowati A, Marwoto P 2015 *J. Innov. Sci. Educ.* **4**.
[27] Magnusson S, Krajcik J, Borko H 1999 *Nature, sources, and developmeent of pedagogical content knowledge for science teaching (pedagogical content knowledge. Lederman NG NG, editor. Vol. 6.* (Nederlands: Kluwer Academic Oublishers)
[28] Astuti WP, Prasetyo APB, Rahayu ES 2012 *Lembaran Ilmu Kependidikan* **41**.
[29] Djamarah SB 2002 *Strategi Belajar Mengajar* (Jakarta: Rineksa Cipta)
[30] Roth WM, Roychoudhury A 1993 *J. Res. Sci. Teach*. **30** 127.
[31] Nuraini I, P K, dan Sudarisman S 2014 *Bioedukasi.* **7** 37.
[32] Hernani H, Mudzakir A, Aisyah A 2009 *J. Pengajaran MIPA* **13**.