7

by 7 7

Submission date: 30-Oct-2020 05:59PM (UTC+0700)
Submission ID: 1431124050
File name: 7_2020_IOP_Unnes_Optics.pdf (709.18K)
Word count: 2522
Character count: 13646

The development of module based on scientific literacy: geometric optics

The development of module based on scientific literacy: geometric optics

N Shofiyah*, and F E Wulandari

Science Education Study Program, Universitas Muhammadiyah Sidoarjo
Kampus I Jl. Mojopahit 666B Sidoarjo, Indonesia

*Corresponding author: nolyshofiyah@umsida.ac.id

Abstract. The purpose of this research is to develop geometry optics module based on scientific literacy in terms of theoretical and empirical. The module was developed by using four-D model. Subject of this study was the geometry optics module which was tried out on first semester students of natural science education by using the one-group pre-test post-test design. The two techniques of collecting data were validation sheets and test. The obtained data then were analyzed with quantitative descriptive. The results showed that the module of Geometric Optic was judged valid in terms of content, performance, language and scientific literacy aspect with average score respectively 3.35, 3.38, 3.44, and 3.50. In addition, the Geometric Optics module-based scientific literacy was categorized easy to understand by cloze test. Based on the results of N-gain analysis, it was obtained an average score of 0.63 which means that the geometry optics module based on scientific literacy was able to improve students' scientific literacy skills.

1. Introduction

Entering 21st century the knowledge and technology development is increasing rapidly which surely need for challenges itself, either educational environment or job world nowadays. Therefore, the preparation of current generation which has skills both soft skills and hard skills for students from elementary school to college level is much needed. Skills in 21st century consists of four principal domain, they are literacy, inventive thinking, effective communication, and high productivity [1].

Scientific literacy is one of the important skills to increase knowledge and problem-solving ability. Scientific literacy is directly correlated with the development of new generation which has firm scientific thoughts and attitudes, and can be communicated effectively in order to deliver the knowledge and the research results to the general society [2]. The new generation in Indonesia should have the literacy skills to live in the society. Thus, the college students and student in general should be introduced the literacy in formal education [3].

Scientific literacy means knowledge and understanding the concept of science and the process that needed in making personal decisions, participations, and economic productivity [4]. It is in line with PISA, stated that Scientific literacy skill is the ability to use scientific knowledge, to identify questions and to draw conclusions based on the evidence to understand and making decisions [5]. Meanwhile, Sadler and Zeidler define scientific literacy as "knowledge and understanding of events and actions in the environment" [6]. In this research, scientific literacy is represented by three student's skills in problem solving, scientific reasoning, and scientific investigation.

From the previous studied, the basic skills of scientific literacy by science education students of UMSIDA are largely in the nominal and functional categories about 39 % and 36 % of students. Meanwhile, there were 20% of students in the conceptual category and 4 % of students in the

multidimensional category. The 1% of students did not provide answers to the literacy tests provided [7].

One of the factors influencing the lack of student's scientific literacy skills is the selection of learning resources. This statement is in line with the result of Firdausy's research which is one of the factors causing the low scientific literacy of students as well as directly and closely related to the students is the source of learning both from the textbook and other sources [8]. Another statement pointed by Ristanto, that teacher play important role as change agents to help students achieving the learning goals such as scientific literacy skills [9].

Based on the description above, it is necessary to develop a science-based literate module, so that the students who have not done the scientific literacy test will be trained how the concept of scientific literacy is. In addition, by having scientific literacy skills, students will have the ability to use scientific knowledge in making personal decisions or used in cultural and society activity, also for economic productivity [10].

To solve the problems related to the scientific literacy, researchers offer several solutions. As performed by Astuti, et al, she used authentic assessment to increase scientific literacy [11]. In research studies conducted by Maturradiyah & Rusilawati [12] and Adisendjaja [13], that science textbooks used in schools emphasize of scientific knowledge which presents facts, concepts, principles, laws, hypotheses, theories, models, and questions that ask the student to remember the knowledge or information. As the results, this study aimed to develop the module based on scientific literacy focus on geometric optics topic in terms of theoretical and empirical.

2. Methods

This study was the developmental research, because the researcher developed the module of geometric optics-based scientific literacy by adapting the four-D model (Define, Design, develop, and disseminate) by Thiagarajan. The first stage was analyzing the students, the concepts, the task, and then formulating the learning objectives. The second one included preparing the prototype of the module. The developed module validated by two experts. The results of validation were analyzed by quantitative descriptive using the below categories:

Table 1. The criterion of validation results

Score Interval	Categories
$4 \leq P < 5$	Very good/Valid
$3 \leq P < 4$	good/Valid
$2 \leq P < 3$	Adequate/not valid
$1 \leq P < 2$	Poor/not valid

After several revisions, the module was piloted to the 10 students to know the level of text legibility of module by using cloze test. According to Bormuth's 1971 study, the cloze score range can be categorized as 0 to 34% is the 'frustrational' level; 35 to 49% is the 'instructional' level and 50% and above is the 'independent' level [14].

In addition, to identify the influence of module toward the scientific literacy skills, the module was tried out to the 1st semester students of natural science education study program at Universitas Muhammadiyah Sidoarjo by using the one-group pre-test post-test design. The test of scientific literacy skills were administered to the students before and after the implementation of the developed module. The obtained data were then analyzed using an N-gain score [15].

3. Results and Discussion

3.1. The Theoretical Feasibility of the Module

The theoretical feasibility of product or science module was assessed by the content, performance, language, and scientific literacy feasibility aspects. The first validator focused on science concepts of

the module. The second validator concerned more on the module because she is a lecturer of Learning Media Course. The validation results can be seen in the graph below:

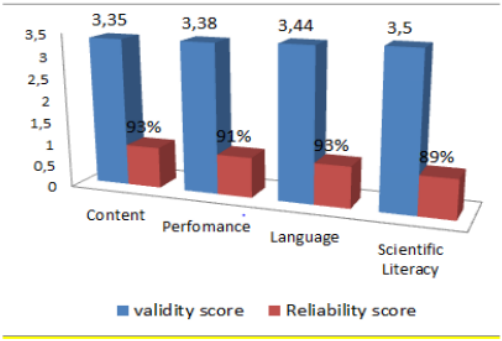

Figure 1. The Validation Results

The figure 1 showed that the module-based scientific literacy were valid or feasible to be implemented in the classroom. The average score of content aspect was 3.35 categorized good/valid, performance aspects was 3.38 categorized good/valid, language components was 3.34 categorized good/valid, and scientific literacy aspect was 3.50 which also categorized good/valid. In addition, the average reliability score was 91.5 %.

3.2. The Empirical Feasibility of the Module

The feasibility of the geometry optics module based scientific literacy in terms of empirical was seen in two manners, namely the readability and the effectiveness of the module.

3.2.1. The Readability of the Module

The module that has been stated valid was evaluated using a cloze test. Such test is used to determine the comprehension of module. The results would show whether the geometric optical module are easy to understand or not. The sheet of readability test is addressed to the students of fourth semester after reading and understanding the developed module. The results of this test were presented in the table 2:

Table 2. The Results of Readability Test

Students	Gained Score	Max Score	%
1	25	28	89,3%
2	26	28	92,9%
3	22	28	78,6%
4	20	28	71,4%
5	18	28	64,3%
6	22	28	78,6%
7	26	28	92,9%
8	25	28	89,3%
9	23	28	82,1%
10	21	28	75,0%
	Average		81,4%

The average score in the table was 81,4%. According to Bormuth, if the score is above 50%, it means that the reading is categorized as independent level. In other words, the module was easy to read and understand.

3.2.2. The Effectiveness of the Module

The developed module that have been stated valid, then applied on the science education students in the second semester. The implementation is to determine whether the module that was developed effectively to improve student's scientific literacy skills or not. The product effectiveness can be seen from the increase of students scientific literacy test score.

Based on the analysis results using N-gain score, it was obtained average score of g = 0.61 which means that the developed geometric optics-based scientific literacy materials have a sufficient effect on student's scientific literacy skills. It shows that the developed module was effective to increase the student's scientific literacy skills.

In the figure 2 is a comparative graph of the pre-test and post-test scores of student's scientific literacy skills for each indicator.

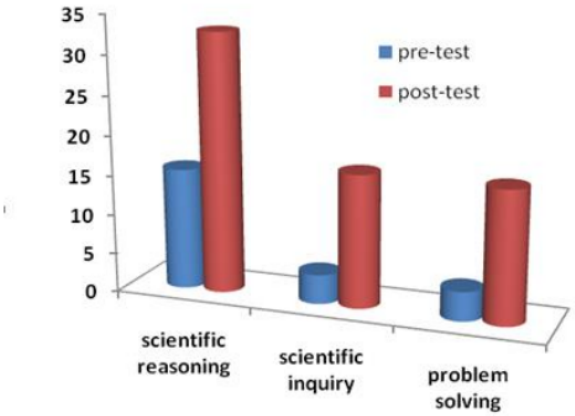

Figure 2. The average score of student's scientific literacy skills for each indicator

Based on the graphic above, the most dominant scientific literacy skill indicator that mastered by the student is scientific reasoning skills. The explanation of this results is that dominant science aspect in the the developed geometric optical materials was science as knowledge body. Therefore, the students were able to use the existed concepts to explain the offered problems. Scientific reasoning is part of students' skill to combine the concepts in explaining natural phenomena. The students are able to explain basic fact of phenomenon and remember knowledge from textbooksk, but not being able to justify their own opinions based on a given text or graph. The students even know the concept of interdisciplinary, but are unable to describe the relationship between the concepts [16].

The other indicators of scientific literacy skills are scientific inquiry and problem solving. To provide students about the scientific inquiry skill, there was feature "Mencoba Yuk" that facilitate students to conduct experiment. Through the experiment, the students learned about scientific process skills, including formulating problems, defining hypotheses, explaining experimental variables, collecting data, analyzing data, and drawing conclusions. However, it does not make the student are able to decide the scientific method creatively in different problems offered. There was also feature "Ayo Berpikir Ilmiah" in the developed geometric optical materials. This feature train students to be able to solve the problems associated with daily life. However, the results showed that the students are lack of problem solving skills. The main reason why the students are still lack of both skills is because they not yet accustomed to solve problems related to the science process skills and technology society [16].

Beside module, the successful in the learning process is also influenced by methods and learning strategies. In this learning process, the teacher use reading and lecture learning strategies. This learning strategy is chosen to make students freely explore the knowledge. The teacher is only a facilitator that provides justification if there is some misconceptions. This learning strategy begins with reading activity, and if this learning strategy is combined with science based-literate materials

would produce a positive impact on student learning outcomes. This is in accordance with the results of the study conducted by Taslidere and Eryilmaz which is the integration of reading strategies, and the use of scientific literacy materials provides a significant positive effect on the improvement of students' cognitive learning outcomes, compared with other learning strategies and methods [20]. In his study, Taslidere and Eryilmaz used science based-literate materials written by Paul G. Hewitt entitled Conceptual Physics.

4. Conclusion

Based on the research results, it can be concluded that the developed module based-scientific literacy focus on geometric optic materials was valid and feasible to be implemented in the classroom. The geometric optics module-based scientific literacy materials have criteria easy to understand and sufficient effective to improve student's scientific literacy skills.

To increase the quality of the developed module, re-checking the content by asking some volunteers to correct the materials was needed. In addition, teacher or lecturer of science education program needs to pay special attention on the problem solving skill and inquiry skill. Based on research data, found that students tend to be less ability in applying the skills in new condition.

References

[1] Turiman P, Omar J, Daud A M, and Osman K, 2012 *Procedia. Soc. Behav. Sci.* **59** 110
[2] Gormally C, Brickman P, and Lutz M 2012 *CBE—Life Sci. Educ.* **11** 364
[3] Prihantya T I, Mitarlis, and Maulida A N 2016 *J. Ilm.* **1** 1
[4] Baram-tsabari A and Osborne J 2015 *J. Res. Sci. Teach.* **52** 135
[5] Kastberg D, Chan J Y, and Murray G 2016 *Performance of U.S. 15-Year-Old Students in Science, Reading, and Mathematics Literacy in an International Context* First Look at PISA 2015 (NCES 2017-048) (Washington DC: National Center for Education Statistics)
[6] Spargo P E 2016 *Public Underst. Sci.* **5**, 331
[7] Shofiyah N 2015 *J. Pedagog.* **4** 31
[8] Ekantini A and Wilujeng I 2018 *Univers. J. Educ. Res.* **6** 1339
[9] Ristanto R H, Zubaidah S, Amin M, and Rohman F 2017 *Int. J. Res. Rev.* **4** 23
[10] Sulaiman S, Bakar N, Arshad M Y, Ismail Z, and Phang F A 2014 *Indones. J. Educ. Rev.* **1** 104
[11] Alpaslan M M, Yalvac B, and Loving C C 2015 *Eurasia J. Math. Sci. Technol. Educ.* **11** 207
[12] Sorvik G O and Mork S M 2015 *Nord. Stud. Sci. Educ.* **11** 268
[13] Sinaga P 2017 *J. Turkish Sci. Educ.* **14** 92
[14] Ajideh P, Yaghoubi M, and Khalili A 2017 *Adv. Lang. Lit. Stud.* **8** 91
[15] Hake R R 1999 *American Educational Research Association* pp. 1–4
[16] Taslidere E and Eryilmaz A 2012 *Res. Sci. Educ.* **42** 181

7

ORIGINALITY REPORT

9%	9%	6%	2%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	pt.scribd.com Internet Source	3%
2	hdl.handle.net Internet Source	2%
3	icmseunnes.com Internet Source	2%
4	www.atlantis-press.com Internet Source	2%

Exclude quotes	On	Exclude matches	< 2%
Exclude bibliography	On		