Development of teaching materials like PISA for physics mechanical wave topic in high school

Development of teaching materials like PISA for physics mechanical wave topic in high school

Nurdianita Fonna[1*], Wawan Bunawan[2] and Derlina[3]
[1]Departement of Physics Education, Postgraduate State University of Medan, Medan,Indonesia
[2,3]Postgraduate State University of Medan, Medan, Indonesia

*Email : fonnanurdianita@gmail.com

Abstract. This study aims to describe the validity, practicality and effectiveness of physics teaching material like PISA. The method carried out in this study uses Research and Development (R&D) development research using the ADDIE model consisting of 5 main phases or stages, namely 1) Analyze (Analysis), 2) Design (Design), 3) Develop (Development), 4) Implement (Implementation), 5) Evaluate (Evaluation). Physics teaching materials developed in the form of teaching materials like PISA. The subjects in this study were students of class XI MIA I SMA Swasta Dharma Pancasila Medan. The results of the study obtained that the validity of teaching materials to the material by the validator obtained results from the content feasibility aspect of 88%, the language feasibility aspect by 86% and the presentation feasibility aspect by 87% while the validity of the teaching materials to the media by the validator obtained a result of 87% so that it met the category valid. The results of the effectiveness test show that teaching materials are effective for use in the learning process with a percentage value of 82% with a very effective category. The practicality of teaching materials in the very practical category of student responses obtained a percentage value of 90%. This shows that the physics teaching materials like PISA have met the valid, practical and effective criteria. And there is an increase in student learning outcomes in the good category after applying high school physics teaching materials like PISA

1. Introduction

Education is a conscious and planned effort to create a learning atmosphere and learning process so that students actively develop their potential to have religious spiritual strength, self-control, personality, intelligence and skills needed by themselves, society, nation and state. The government realizes that education is very important as a foundation for the creation of a developed and competitive country. Knowledge in education and learning must be changed so that in the future young Indonesians will be able to outperform machine intelligence and be wise in using machines for the benefit.. The 21st century is marked by the era of the industrial revolution 4.0 as the century of openness or the century of globalization, meaning that human life in The 21st century undergoes fundamental changes that are different from the way of life in the previous century. It is said that the 21st century is a century that demands quality in all human endeavors and results. The 21st century naturally demands quality human resources, which are produced by professionally managed institutions so as to produce superior results in education.

Education, if it refers to the word, will definitely lead to a process in which a teacher teaches something material to students. Teaching means giving something knowledge or adding insight to someone from not knowing to knowing. One of the important components in educational activities and the learning process is the educator or teacher. The level of quality and competence of teachers can be said to be the main obstacles, ranging from teachers who do not have the appropriate competence to teach certain subjects, to the low level of professionalism of the teachers themselves. Even though technological advances have provided a variety of tools to improve the effectiveness of the learning process, the teacher's position cannot be completely replaced. That means the teacher is an important variable for the success of education. Teachers must be professionally sensitive to global educational issues in a variety of subjects and able to relate teaching to other subjects and to real-life situations (Edwards, 2010).

Physics is part of the branch of science, therefore learning physics is also part of learning science. Science learning is expected to be a vehicle for students to learn about themselves and the environment, as well as prospects for further development and application in everyday life (Depdiknas, 2008). Physics is also a part of learning for junior to senior high school students. Physics learning which is a learning that is considered difficult because it is related to calculations and analysis becomes a challenge for teachers in the learning process. Students often assume that learning physics that is applied in schools so far is a separate lesson from the world in which the student is located. This causes students to be unable to relate the knowledge they learn to the phenomena that occur around them. The students are very good at memorizing, but are still not skilled in using the knowledge they have (Paramita, et al., 2016).

The ability of students to master and learn science is closely related to the development of science and technology which is currently increasingly rapidly so that students are required to have good literacy skills (Kurnia, Zulherman, et al, 2014). However, the reality on the ground shows that the scientific literacy ability of Indonesian students is still low. This is in accordance with the results of the Program for International Student Assessment (PISA) study in 2015 that the scientific literacy of Indonesian students was ranked 64 out of 72 participating countries with a score of 397 (PISA, 2015). Indonesia's average score, which is still relatively low, reflects that most students in Indonesia have not been able to analyze and apply concepts to solve a problem. One indicator of the success of students mastering critical thinking, creative thinking, and technology can be seen from the mastery of students' Science Literacy from the PISA Program. The Program for International Student Assessment (PISA) managed by the Organization for Economic Co-operation and Development (OECD) emphasizes the achievement of student scientific literacy (OECD, 2009). (Litbang, 2015) stated the results of the PISA assessment, placing Indonesia in the 60th rank out of 65 countries in 2009. The fundamental question is what can be done to encourage increased student achievement. What role can universities producing science teacher candidates play to improve the scientific literacy competence of their graduates.

One of the international organizations that measures students' literacy skills is PISA (Program for International Student Assessment) which is held every 3 years. PISA emphasizes students' abilities that are obtained from school and can be used to solve problems encountered in everyday life (OECD, 2010). Scientific literacy is defined by PISA as the capacity to use scientific knowledge, identify questions and to draw conclusions based on evidence in order to understand and help make decisions about the natural world and human interactions with nature. Scientific literacy is perceived as a key competency and is defined in the form of an interactive ability to master information resources and technology so that a person is able to move himself to interact with the outside world and in a wider range of uses. (OECD, 2013) for the 2015 PISA program mentioned three scientific literacy competencies that were assessed, namely (1) Explain phenomena scientifically, (2) Evaluate and design scientific inquiry, (3) Interpret data and evidence scientifically.

The implementation of learning that occurs in schools is that teachers in delivering material are more dominant in direct learning which ends with assignments. This teacher-centered learning process causes the attractiveness of the physics lesson itself is still low so it is necessary to evaluate the learning process such as the development of learning procedures using different teaching materials such as Like

PISA so as to make students more interested in carrying out learning. so that researchers are interested in conducting a study entitled “Development of Teaching Materials Like PISA for Physics Mechanical Wave topic in High School”.

2. Method

The type of research used in this research is development research (R&D). The concept used is the development of Analysis, Design, Development, Implement and Evaluation (ADDIE). The analysis phase includes curriculum analysis and analysis of teaching materials. The design stage includes the design of teaching materials accompanied by question instruments. The development stage includes the stages of making teaching materials, expert validation by validators. The implementation phase includes the implementation of the pretest and posttest as well as the teacher's response to the teaching materials to determine the effectiveness of the physics teaching materials developed. The evaluation stage includes the results of student perceptions to determine the practicality of teaching materials.

3. Results and Discussion

3.1 Analysis

The results of the analysis are based on environmental observations at SMA Dharma Pancasila Medan where the learning presented still adheres to the textbooks at school so that it has not been shown in the form of Like PISA teaching materials. The available learning resources used by these students are monotonous and less attractive to these students in doing learning in the classroom so that the textbooks used are lacking in explanations without pictures to understand them, sentences or words used are a little difficult to understand by students in learning.

3.2 Design

The form of teaching materials contained in it starts from a cover that is not too flashy like a cover whose contents are full of writing so that it confuses the reader in reading the writing that is covered starting from which direction when reading the cover, making an image accompanied by what information is in the image. This makes it easier for readers to understand what the meaning of the images presented in the reading of the teaching materials are and make examples of questions in the teaching materials accompanied by the answers and at the end there is a summary as a conclusion from the contents of the book briefly and clearly.

3.3 Development

At this stage there is the manufacture of physics teaching materials where the product design resulting from this development research is in the form of Like PISA teaching materials on mechanical wave material for high school students. The developed teaching materials contain components such as cover display, table of contents display, concept map display, indicators and objectives display, as well as content display of teaching materials and bibliography and are displayed as shown in Figure 1.

Figure 1. Developed Teaching Material Design

The results of expert validation of teaching materials are known from the assessments of experts using a validation questionnaire sheet which is divided into 3 aspects of the assessment, namely aspects of the feasibility of content, language, and presentation. Validity assessment results of teaching materials are presented in Table 1. And the assessment of the validity of the design of teaching materials is presented in Table 2.

Table 1. Validation of Teaching Materials by a Team of Experts

Evaluation	Percentage	Category
Content Eligibility	88%	Very Valid
Language Eligibility	86%	Very Valid
Serving Eligibility	87%	Very Valid
Average	87%	Very Valid

Table 2. Validation of Teaching Material Design by a Team of Experts

Evaluation	Percentage	Category
Teaching Material Size	93%	Very Valid
Teaching Material Cover Design	90%	Very Valid
Teaching Material Content Design	89%	Very Valid
Average	90%	Very Valid

3.4 Implementation

At this stage the teaching materials developed have been validated by the validator so that they are feasible to be applied in classroom learning. This stage also aims to determine the improvement of student learning outcomes in physics teaching materials Like PISA. To find out the effectiveness test of the physics teaching materials developed through the teacher's response to the physics teaching materials are presented in Table 3.

Table 3. Teacher's Perception of Teaching Materials

Evaluation	Percentage	Category
Ease of use	84%	Very effective
Serving Interests	79%	Effective
Benefit	81%	Very effective
Average	82%	Very effective

3.5 Evaluation

At the evaluation or assessment stage, at this stage the assessment of teaching materials is seen from the practical aspect. This practical aspect can be seen from the student perception questionnaire presented in Table 4.

Table 4. Students' Perception of Teaching Materials

Evaluation	Percentage	Category
Material Organizing	92%	Very Practical
Evaluation/Practice Questions	90%	Very Practical
Language	91%	Very Practical
Effects on learning strategies	91%	Very Practical
Visual Display	87%	Very Practical
Average	90%	Very Practical

4. Conclusion

Based on the results of research and discussion, it can be concluded that the physics teaching materials like PISA that have been developed have met the level of validity in the good category. The results of the trial of teaching materials showed that the teaching materials that had been developed were effective and practical, but the results obtained were not optimal. This research is expected to develop teaching materials that can be further improved in the future.

References

[1] Depdiknas. (2008). *Panduan Pengembangan Bahan Ajar.* Jakarta : Depdiknas.
[2] Edward, E. & Alire, C. 2010. *Academic Librarianship*. New York: Neal-Schuman Publishers, Inc.
[3] Kurnia,F., Zulherman, Fathurohman,A. (2014). Analisis Bahan Ajar Fisika SMA kelas XI di Kecamatan Indralaya Utara Berdasarkan Kategori Literasi Sains. *Jurnal Inovasi dan Pembelajaran Fisika Universitas Sriwijaya. 1(1)*
[4] OECD.(2009).PISA 2009 Assessment Framework: Key Competencies in Reading, Mathematics, and Science. USA: OECD-PISA
[5] OECD. 2010. *PISA 2009 Results: Executive Summary*. New York: Columbia University
[6] OECD. 2016. *PISA 2015 Results in Focus*. New York: Columbia University.
[7] OECD. 2019. *PISA science literacy in the 2018 PISA Assessment and Analytical Framework.* Paris: OECD Publishing.
[8] Paramitha,A.D., A.Rusilowati., Suagianto. (2016). *Pengembangan Bahan Ajar Berbasis Literasi Sains Materi Suhu Dan Kalor.* Semarang : Universitas Semarang
[9] Sahyar & Bunawan,W. (2019*).* Pengembangan Bahan Ajar Materi Gelombang Berbasis Pisa (Programme For International Student Assessment) Pada Program Studi Pendidikan Fisika. *Jurnal Pendidikan Fisika*. 8(1): 115-116