Developing Physics Learning Module Based on Guided Inquiry (PLM-BGI) for Work and Energy

Endang Susilawati
Program Studi Pendidikan Fisika
STKIP Taman Siswa Bima
Bima, Indonesia
endsusiawati001@gmail.com

Agustinasari
Program Studi Pendidikan Fisika
STKIP Taman Siswa Bima
Bima, Indonesia
atinasari23@gmail.com

Achmad Samsudin
Program Studi Pendidikan Fisika
Universitas Pendidikan Indonesia
Bandung, Indonesia
achmadsamsudin@upi.edu

Parsaoran Siahaan
Program Studi Pendidikan Fisika
Universitas Pendidikan Indonesia
Bandung, Indonesia
parsaoransiahaan@upi.edu

Syahriani Yulianci
Program Studi Pendidikan Fisika
STKIP Taman Siswa Bima
Bima, Indonesia
yulianci.syah@gmail.com

***Abstract*—The aim of this research was to develop physics learning module based on guided inquiry (PLM-BGI) for work and energy. The module was developed using 3D: Define, Design, and Develop. The module was validated by two experts, a peer, and an education practitioner. There were 4 (four) aspects used as the judgment indicators among others: content appropriateness, presentation appropriateness, language appropriateness, and relevance to guided inquiry. The result of the research showed that developing physics learning module based on guided inquiry (PLM-BGI) for work and energy was appropriate in excellent category based on the whole result of the validation.**

***Keywords*— Module, Guided Inquiry, Work and Energy**

I. INTRODUCTION

Module is an important component in the learning process. An appropriate module helps students organize learning materials to conform to predetermined indicator standards. The availability of the module can make students more independent in the learning process. Module is also called media for independent learning because it has been equipped with instructions for self-study [1]. However, the development module needs to be reviewed based on the needs of the students.

As a result of an interview with a teacher at a senior high school, teaching materials which were available at the school have not been developed based on the characteristics of the lesson yet, especially science materials. Similarly, work and energy materials due to the fact that students generally only learn work and energy materials theoretically. Work and energy materials, especially kinetic energy and potential energy materials are only visualized through description in students' mind. Consequently, students do not get a full description of how the investigation and application of energy materials used. Physics as a lesson in a cluster of science, needs to be directed to find out and to carry out such as a scientific investigation activity. Mary [2] says that science learning should be focused on two aspects: process skills and higher thinking skills. Students' science competencies need to be developed in class through strategies or models that support the development of students' science competencies [3]. Therefore, developing a module is necessary to direct students to find out and conduct scientific investigations.

To make students actively involved and have direct experiences, modules must be used in constructivist learning in order to provide opportunities for students to construct their own knowledge [4]. One of the learning methods that supports students to conduct scientific investigations and to construct their own knowledge is inquiry.

Inquiry is a learning method based on scientific method. Inquiry is a student-centered learning strategy and guides in a situation that requires to search and to find answers to questions [5]. Hence, the meaning of what they learn can increase [6].

Inquiry trains students to be active. Teacher's role in inquiry learning is as a facilitator [7]. Teachers guide and direct more in order to make students trained to construct knowledge through learning by doing.

The use of context in inquiry learning can improve students' understanding in learning. The use of context in the process of science learning is an attempt to bridge the gap between abstract concepts and everyday life [3]. After using inquiry-based modules, students' understanding of concepts and thinking skills will be better. This is supported by the result of Ginanjar's study [8] which says that inquiry learning can increase students' motivation so that learning outcomes increase. Jonson's research [9] also proves that inquiry learning model provide opportunities for students to practice problem solving and critical thinking.

Based on the explanation above, the aim of this research is to develop physics learning module based on guided inquiry (PLM-BGI) for work and energy.

II. MATERIALS AND METHODS

This research method was a development research (Research & Development). The development steps of the module used 4D model: Define, Design. Develop, and Disseminate. However, for this research, due to the limited time, the steps used were only 3D (Define, Design, and Develop).

The module developed in this research was a module integrated with guided inquiry learning. According to Parmin & Peniati [10], a module is an organization of materials, so students can understand the relationship between facts, concepts, procedures, and principles contained in learning materials.

Inquiry is a learning method that can help students to solve problems and draw conclusions from investigations conducted [11]. The purpose of inquiry is to involve students in the process of developing knowledge of science through the steps of inquiry [12]. Hence, PLM-BGI is a module used in physics learning which consists of work material and energy material and contains description of problems or conditions in learning work and energy materials. In addition, it can encourage students to investigate, analyze data, and draw conclusions.

The subjects were senior high school students in class XI on work and energy materials. The validation of the module was judged by two experts, a peer, and an education practitioner. There were validated items in this study consisting of 4 (four) aspects, namely content appropriateness, presentation appropriateness, language appropriateness, and relevance to guided inquiry.

After obtaining the validation result, the validation score was converted to the criteria in Table 1.

TABLE I. LIKERT-SCALE CRITERIA

Percentage	Category
0% - 20%	Very Poor
21% - 40%	Poor
41% - 60%	Enough
61% - 80%	Good
81% - 100%	Excellent

In addition to the criteria, data analysis was also carried out with the following formula to find out the percentage of ideal:

$$Percentage = \frac{\text{Obtained } total\ score}{Maximum\ score}\ x\ 100\% \quad (1)$$

III. RESULT AND DISCUSSION

In this development research, physics learning module based on guided inquiry (PLM-BGI) for work and energy was developed to the second semester of the class X of the high school students on work and energy materials. This learning module consisted of 4 subchapters, namely: work, energy, work and energy change, and the law of conservation of mechanical energy. While the module was being designed, suggestions from two experts and a peer were accepted. The module was subsequently revised and developed. After the revision and development, the module was judged by two experts, a peer, and an education practitioner.

Development of physics learning module based on guided inquiry (PLM-BGI) for work and energy used 3D model, with the following research data:

A. *Define*

Based on the identification of the problems that have been done, a module was decided to be developed. This module was the development of a physics learning module that combines the module with guided inquiry steps. The defining steps that have been taken were: 1) the research subjects were carried out in senior high school; 2) integrating the module with problems in daily life; 3) adding investigation activities to understand problems in surroundings using guided inquiry model; 4) the contents were work and energy materials.

B. *Design*

The design steps in making physics learning module based on guided inquiry (PLM-BGI) for work and energy were as follows: 1) determining materials; 2) setting learning objectives, making list of subjects and subtopics proposed, and arranging indicators; 3) determining the issues raised to be solved in guided inquiry, 4) writing the contents of the materials in the module containing contextual inquiry.

C. *Develop*

Development of physics learning module based on guided inquiry (PLM-BGI) for work and energy integrated the materials with inquiry activities guided by the teacher. To understand the materials better, the module was equipped with contextual problems that stimulate students to submit problem formulations in inquiry.

After the materials and inquiry activities were arranged, the next step, to validate the module to two experts, a peer, and an education practitioner. This was done to find out whether the prepared instruments were appropriate or not and could measure what would be measured. The module quality judgment was done by filling out the judgment scale sheet that has been provided. The sheet consisted of 4 aspects of judgment which were divided into 16 components and 50 judgment criteria with their elaboration. The result of the judgment in the form of quantitative data was then tabulated and analyzed to determine the quality of physics learning module based on guided inquiry (PLM-BGI) for work and energy. The result of the expert validation could be seen in Table 2.

TABLE II. EXPERT VALIDATION

Judgment Aspect	Percentage	Category
Content	76.5	Good
Presentation	81.6	Excellent
Language	79.2	Good
Relevance to guided inquiry	84	Excellent
Total Score	80.3	Excellent

Subsequently, the result of the peer validation could be seen in Table 3.

TABLE III. PEER VALIDATION

Judgment Aspect	Percentage	Category
Content	80	Good
Presentation	76.7	Good
Language	80	Good

Judgment Aspect	Percentage	Category
Relevance to guided inquiry	92	Excellent
Total Score	82.1	Excellent

The result of the education practitioner validation could be then seen in Table 4.

TABLE IV. EDUCATION PRACTITIONER VALIDATION

Judgment Aspect	Percentage	Category
Content	90	Excellent
Presentation	88.3	Excellent
Language	86.1	Excellent
Relevance to guided inquiry	88	Excellent
Total Score	88.1	Excellent

All in All, the whole result of the module validation could be seen in Table 5.

TABLE V. VALIDATION RESULT

Judgment Aspect	Percentage	Category
Content	80.7	Excellent
Presentation	82.1	Excellent
Language	81.2	Excellent
Relevance to guided inquiry	87	Excellent
Total Score	81.8	Excellent

In the judgment of the content aspect, the percentage was 80.7% in excellent category. It showed that the content aspect was in accordance with the targeted component appropriateness. The component appropriateness consisted of: (1) content feasibility; (2) material accuracy; (3) learning material support; (4) material novelty. Based on the validation result, the material attractiveness was still relatively low. This was due to there was not design variation yet of the module developed.

Then, in the judgment of the presentation aspect, the percentage was 82.1% in excellent category. It indicated that the presentation aspect was in line with the targeted component appropriateness. The component appropriateness consisted of: (1) technique of presentation; (2) presentation support; (3) learning presentation; (4) presentation completeness. Based on the validation result, the layout of the formula was somewhat irregular and there were some symbols not consistent to be used.

Subsequently, in the judgment of the language aspect, the percentage was 81.2% in excellent category. It pointed out that the language used was (1) straightforward; (2) communicative; (3) dialogue and interactive; (4) compatibility with the level of students' development; (5) use of terms, symbols or icons.

Moreover, in the judgment of the relevance to guided inquiry, the percentage was 87% in excellent category. It showed that the content aspect was in accordance with the targeted component appropriateness. The component appropriateness consisted of: (1) contextual; (2) problems; (3) investigation activity. It meant that the module was related to guided inquiry.

Based on the quantitative score percentages above, the percentages were then converted into qualitative categories. The percentage of ideal of the validation of physics learning module based on guided inquiry (PLM-BGI) for work and energy was 81.8% in excellent category.

PLM-BGI is appropriate for work and energy materials because this module can help students to learn physics materials through investigation. Through PLM-BGI, work and energy materials are not only discussed in the aspect of knowledge, but also students are guided to discover theories related to work and energy and the application of work and energy in daily life.

At the beginning of learning, students are demand to solve problems or cases in daily life. Therefore, students feel challenged to learn the relationship between the problems and physics, especially work and energy. In addition, the existence of inquiry activities in learning also makes students not only gain knowledge, but also scientific skills. The scientific skills obtained are formulating problems, writing hypotheses, skills in conducting experiments, analyzing data, and concluding.

IV. Conclusion

Physics learning module based on guided inquiry (PLM-BGI) for work and energy was appropriate to be used because the percentage of ideal was 81.8% in excellent category. The module could be developed further. In addition, other modules were necessary to be developed in similar researches on other materials so that the modules can increase knowledge on other materials for students.

Acknowledgment

We would like to express our thanks to Ministry of Research and Technology/National Agency for Research and Innovation, Republic of Indonesia who funded this research grant in the fiscal year 2019.

References

[1] Sugiyanto., Ika, K., Joko, P. Pengembangan modul ipa terpadu berbasis sains-lingkungan-teknologi-masyarakat dengan tema teknologi biogas, Jurnal Kependidikan, 42, 1, 54-60, 2012.

[2] Mary, L, A.. Mastery of science process skills and their effective use in the teaching of science: an educalogy of science education in the nigerian context, International Journal of Educalogy, 16, 1, 11-30, 2002.

[3] Intan, M., Sri R., Fauziatul, F. Pengaruh pembelajaran inkuiri berkonteks socioscientific-issues terhadap keterampilan berpikir kritis dan scientific explanation, Jurnal Kependidikan, 3, 1, 52-66, 2019.

[4] Endang, N, T., Abdur, R, A., Makbul, M. Pengembangan modul pembelajaran matematika dengan pendekatan inkuiri untuk membantu siswa sma kelas x dalam memahami materi peluang, Jurnal Pendidikan, 10, 1, 1938-142, 2010.

[5] Derlina., Afriani, N, L. Efek penggunaan model pembelajaran inquiry training berbantuan media visual dan kreativitas terhadap keterampilan proses sains siswa, Cakrawala Pendidikan, 35, 2, 153-163, 2016.

[6] Rizal, M. Pengaruh pembelajaran inkuiri terbimbing dengan multi representasi terhadap keterampilan proses sains dan penguasaan konsep ipa siswa smp, Jurnal Pendidikan Sains, 2, 3, 159-165, 2014.

[7] Izaak, H, W., Katerina E., Venty. Analisis kesulitan belajar dan pencapaian hasil belajar siswa melalui strategi pembelajaran inkuiri, Cakrawala Pendidikan, 35, 3, 378-385, 2016.

[8] Ginanjar, A. Pengaruh metode belajar inkuiri terhadap motivasi belajar siswa smp. Jurnal Kependidikan, 45, 2, 13-129, 2015.

[9] Jonson, C. Acitivities process-oreinted guided inquiry learning (pogil) in the foreign language classroom, A Journal of the American Association of Teachers of German, 14, 1, 30-38, 2011.

[10] Parmin & Peniati, E. Pengembangan modul mata kuliah strategi belajar mengajar ipa berbasis hasil penelitian pembelajaran, Jurnal Pendidikan IPA Indonesia, 1, 1, 8-15, 2012.

[11] Mcnew-birren J & Kieboom LA Van Den. Exploring the development of core teaching practices in the context of inquiry-based science instruction: An interpretative case study. Teaching and Teacher Education, 66, 74-87, 2017.

[12] Brigita, B. & Zuzana, J. Impact of inquiry activities in physics teaching on the level of students' inquiry skills. Conf Series: Journal of Physics, 1076, 1-10, 2018.