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Problem-Based Learning (PBL) Physics Teaching Books Newton's Gravity Force

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Abstract: The purpose of this research is to test the validity and feasibility of physics textbooks that have been developed based on *Problem Based Learning* (PBL) on Newton's gravitational force material. This research uses development research methods. The validation sheet is used as a research instrument. The validation sheet was validated by two experts and declared valid according to predetermined criteria. Textbook validation data was collected from two experts, one textbook media expert and one physics material expert. There are two aspect criteria that are tested for validity, the form of dialogical and interactive presentation of language and the contextual nature of textbooks. The purpose of this research approach is to describe the effectiveness, validity and feasibility of using physics textbooks. The research results obtained are the percentage of aspects of dialogic and interactive language validation as well as aspects of contextual nature that have been tested by material experts obtained an average percentage of 87.5%, which means that the physics textbooks that have been developed are included in the feasible criteria. The results of the research tested by media experts on aspects of dialogic and interactive language as well as on aspects of contextual nature both obtained an average percentage of 100%. This means that a physics textbook based on Problem Based Learning (PBL) on Newton's gravitational force is very feasible to be tested based on validity testing by one material expert and one media expert.

Keywords: Newton's Gravity; Problem Based Learning (PBL); Textbooks; Validation.

Introduction

Currently, education is entering a new paradigm era in which students are the center of learning. In this case, students seek their own knowledge with the teacher as a facilitator. The new paradigm of education shifts the old paradigm in which the teacher is the center of students in gaining knowledge. In fact, learning is a process of seeking, without seeking, students will never find knowledge and will not be successful in their life. There are 2 factors that determine the success of students in learning, namely internal factors and external factors. Internal factors come from the students themselves such as interests, intelligence, talents and others. While external factors are factors outside of students, such as environmental influences, school, friendship and so on.

Physics is one of the sciences that is considered difficult and boring by students because it deals with calculations and numbers. Therefore, in learning physics an innovation is needed that can stimulate and attract students' interest in learning physics. One of these innovations is to create a physics textbook based on problems. In this case, textbooks are prepared using the *Problem Based Learning model*. This model is a model that uses a scientific approach. In this case, *Problem Based Learning* is a learning method in which students are given a problem from which later students will learn to find solutions to these problems. *Problem Based Learning* is a learning model that directs and focuses on students.

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In this model, students become *the center* of the teaching and learning process. While the teacher facilitates students during the learning process takes place.

According to Khanafiyah (2012) Problem Based Learning is a learning process that involves students in teaching and learning activities, such as question and answer, finding learning resources, discussions, and designing solutions to the problems being sought. Students are given the opportunity to explore their knowledge through activities to solve and find temporary solutions. In this case, it means that students are given the freedom to express their opinions and hypotheses according to the problem being sought (Nurhayati et al., 2019).

Problem Based Learning can be combined in textbooks, where the contents are related to real life problems related to physics. in preparing textbooks, also pay attention to the phases in Problem Based Learning which consists of five phases. These five phases are orienting, organizing, guiding, developing, and evaluating. In the orienting phase, a problem related to the physics material in the textbook will be given. In the organizing phase, the textbook contains material related to the problems in the first phase. In the guiding phase, a discussion material is presented in the textbook. In the developing phase, in the textbook students are expected to present the results of the discussion. In the evaluating phase, the teacher provides reinforcement of the results in the presentation. From these several stages, it is hoped that students can easily understand the material presented in the textbook.

Books are one example of teaching materials. Teaching materials are materials that consist of systematically arranged texts, information, or tools that are displayed intact to achieve the competence of students. The purpose of making teaching materials is to review the implementation and planning of learning in the learning process (Tania, 2017). In the learning process, teaching materials can be used to assist teachers in learning process activities so that the learning process can occur effectively if the teaching materials used comply with the criteria (Yati and Amini, 2020)

Textbooks are one example of teaching materials used in the learning process. With good and proper planning, textbooks can fulfill the five basic elements of collaborative learning. In order to achieve learning objectives and instructional principles, textbooks need to be well designed. In textbooks, besides explaining the material can also be teaching materials to motivate students in learning, textbooks also provide summaries and explain learning outcomes, and provide exercises. The role of the textbook is that textbooks can develop the insights of teachers and students in providing and improving the quality of a learning process. Learning that is interactive, active, educative, creative, and fun in nature and its activities can achieve the goals of learning. This is good and effective learning that can be achieved from making teaching materials (Purwati and Erawati, 2021)

In the learning process using textbooks, it is necessary to make adjustments to SK, KD, learning materials and use of methods that are appropriate for students. Textbooks can be an enhancer of interaction between educators and students. In addition, students can learn more optimally. Textbooks can support the learning process. Therefore in the textbook there is an explanation of the learning objectives, structured and systematic, there is an anticipation of difficulties in learning, the textbook can foster learning motivation, the textbook also provides a summary. After preparing textbooks, then go through a validation process which includes material expert validation and media expert validation. This validation can be carried out by an expert, students, educators and book publishers (Sutrisno and Puspitasari, 2021).

Before using textbooks, validation needs to be carried out so that the textbooks are in accordance with the learning objectives to be achieved. Validation is a test of attractiveness and practicality of products made by researchers. This validation is usually in the form of a questionnaire. The data from the validation results are used to determine the level of validity and the results of small-scale trials. The product that has been made, the researcher then validates, usually the people who validate it are material experts and media experts. Material expert validation is used for evaluators on material and discussion that has been developed by researchers. Meanwhile, media expert validation is used to evaluate products developed by researchers. Quantitative data and qualitative data are data obtained from the validation results of media experts. These results were obtained by researchers giving questionnaires to media experts (Chrisyarani and Yasa, 2018).

Material expert validation and media expert validation are types of validation. Material accuracy, material completeness, material up-to-date and contextual, communicative, presentation techniques, suitability for student development, dialogic and interactive, contextual nature and contextual components are the components of material validation. While the components in media validation are accessibility and navigation, communication and display quality, the overall function of the media. In a validation study carried out on teaching materials carried out by material experts and cultural experts. The purpose of validation is to find out whether the teaching material is appropriate or not. After validation, the researcher made a revision according to the results of the validation provided by material experts and cultural experts (Wulantina and Maskar, 2019).

In learning physics, currently there is more emphasis on understanding material concepts than solving problems. So that we need materials that can

make students able to master the concept, besides that students can solve problems in learning physics. Therefore, the researcher made textbooks with the aim of developing Problem Based Learning (PBL) based physics textbooks and knowing the validity of Problem Based Learning (PBL) based physics teaching materials on Newton's Gravity Force material.

Method

In this study, the research method used is a type of development research method. The development research method is a type of research by developing problem-oriented teaching materials for high school students using the Problem Based Learning (PBL) learning model of Newtonian Gravity Force Material. The type of teaching material used in this research is the Problem Based Learning (PBL) Physics Textbook on Newton's Gravity Force Material.

The research instrument used in this study is a validation sheet from the validator. This validation sheet was validated by 2 expert validators and has been declared valid with certain criteria. The process of collecting textbook validation data was carried out by 2 experts, namely 1 textbook media development expert, 1 physics expert. There are 2 aspects that are assessed, namely the form of dialogical and interactive presentation of language and the contextual nature of textbooks. This research method aims to describe the effectiveness and validity of using these textbooks for high school students. In addition, it aims to ensure that the textbook is in accordance with the principles of contextual nature and uses dialogic and interactive language and contextual nature so that it can be effective in supporting physics learning. Each aspect has several assessment criteria.

To find out the eligibility test for textbooks, it can be seen based on the feasibility calculation with the equation 1. where P is the symbol for the percentage of eligibility textbooks, f is the due diligence score obtained, and N is the maximum due diligence score. The eligibility criteria for textbooks developed by researchers can be identified based on the eligibility criteria table below. Textbooks are said to be appropriate if they have a percentage score of more than 70%. If the score is below 70%, the textbook cannot be said to be feasible and it is necessary to revise it to be re-tested by the validator.

$$P = \frac{f}{N} \times 100\% \quad (1)$$

Table 1. Textbook Eligibility Criteria

Percentage of eligibility (%)	Interpretation
25.00 – 49.00	Not Feasible
50.00 – 69.00	Decent enough
80.00 – 84.00	Worthy
85.00 – 100.00	Very worth it

Results and Discussion

In this study, physics teaching materials using Newtonian gravity based on Problem Based Learning (PBL) can be developed through articles that will be published on valid websites. After the development activities were carried out, it was continued with due diligence on a team of experts where there was 1 media expert and 1 material expert. Validation for the expert team was given an instrument in the form of an assessment rubric which contained nine indicators which consisted of completeness of material, accuracy of material, updating of material and contextual, presentation techniques, communicative, dialogic and interactive, conformity with student development, contextual nature and contextual components. In this study, there are 2 aspects that are assessed, namely the form of dialogical and interactive presentation of language and the contextual nature of textbooks. So that it can be concluded through the opinions of the 2 experts by going through the table.

The feasibility test of this textbook was prepared with a validation assessment from material experts and media experts. The validation of the textbooks assessed is regarding 2 aspects of validation including contextual aspects and language aspects. Language validation related to communicative means the clarity of language use, and the readability of messages and information. Then on dialogic and interactive, namely the ability to motivate students. And the suitability of developments that occur in students related to the suitability of intellectual development in students. In the use of dialogic and interactive language, what is meant is being able to motivate students and can encourage students to increase students' critical thinking about the material that has been presented. The results of the validation test from the material expert are presented in Table 2.

Table 2. Material Expert Validation Score Table

Aspects tested	Indicator	Score	Percentage (%)
Language	Dialogic and Interactive	3	75.00
Contextual	Contextual Nature	4	100.00
Average percentage			87.50

From the validation results of the table above in the dialogic and interactive language aspects section, a score of 3 is obtained with a percentage of 75%, which means that the textbooks that have been developed can be declared feasible. In every aspect - the dialogic aspects contained in this textbook are included in the good category. So that in the Physics textbook based on Problem Based Learning (PBL) Newton's Gravity Force material it was found that the language used was communicative, interesting and able to motivate

students to study the textbook. Not only motivating students, but the language used must also be able to encourage students to think more critically. Students' critical thinking skills can be created by using stimulating language, so that students have further curiosity and can find answers independently through textbooks or other sources.

The aspect that is tested next is the contextual aspect with the validated indicator being the contextual nature of the textbook. Contextual nature is related to the ability of students to connect material with application in everyday life. Based on the validation of material experts, it is known that contextual nature has a score of 4 with a percentage of 100% stating that the physics textbook that has been developed is very feasible to be used by students as a learning resource. This Problem Based Learning (PBL) based physics textbook is presented with the relation of Newton's gravitational force material to natural phenomena and applications related to everyday life. In this Problem Based Learning (PBL) physics textbook there are group discussions that invite students to work together to solve problems of Newton's gravitational force in everyday life. Students can experiment with planetary motion in the solar system using a bekel ball. From the results of these experiments students are expected to be able to conclude events that occur regarding planetary motion.

Table 3. Media Expert Validation

Aspects tested	Indicator	Score	Percentage (%)
Language	Dialogic and Interactive	4	100
Contextual	Contextual Nature	4	100
Average percentage			100

The next validation or the second validation was carried out by 1 media expert who tested the language and contextual aspects. The results of the validation test are presented in the table 3. From the validation results on the dialogic and interactive language aspects table, a score of 4 is obtained, which means that the textbook that has been developed is very good. The percentage obtained in this dialogic and interactive language aspect is 100%, which means that this PBL-based physics textbook is very feasible to be tested and used by students as a learning resource. This PBL-based physics textbook is presented coherently with dialogic and interactive language in it which is easy for students to understand in learning.

The aspect that is tested next is the contextual aspect with the validated indicator being the contextual nature of the textbook. Based on the validation of media experts, it is known that contextual nature has a score of 4 with a percentage of 100%, which means that this textbook is very feasible. This textbook is presented in a book arrangement that is easy to read and understand by students. In this PBL-based physics textbook there is a description of the phases according to the Problem Based Learning (PBL) component. The phase components are presented in a coherent and neat manner so that students can use textbooks to support their learning activities. The type of font used in this book also makes the view comfortable when reading. The addition of pictures, illustrations and graphics presented in this textbook also becomes students' interest in reading and learning.

Conclusion

Based on the results of the research described above, it was found that the physics textbook based on Problem Based Learning (PBL) on Newton's gravitational force material had been validated by 1 material expert and 1 media expert. There are 2 aspects that are assessed, namely the form of dialogical and interactive presentation of language and the contextual nature of textbooks. The results of the validation test conducted by a subject matter expert on the dialogic and interactive aspects of language obtained a score of 3 with a percentage of 75%, which means that the physics textbook based on Problem Based Learning (PBL) on Newton's gravitational force material that has been developed is good and able to motivate students. In addition, the results of the validation test on the contextual aspect obtained a score of 4 with a percentage of 100%, which means that the textbooks that have been developed are very good and are able to support students' ability to relate material to its application in everyday life. So that the percentage of the average score obtained from the results of the material expert validation test is 87.5%. The Physics textbook based on Problem Based Learning (PBL) material on Newton's gravitational force was also validated by a media expert where the results of the validation test on the language aspect obtained a very good score, namely with a score of 4 or with a percentage of 100%, as well as the results of the validation test on the contextual aspect also obtained a score of 4. So that the percentage of the average score obtained from the results of the media expert validation test was 100%. It can be concluded that the physics textbook based on Problem Based Learning (PBL) on Newton's gravitational force material as a whole has fulfilled good criteria so that it is hoped that it will be able to support learning outcomes in the physics learning process.

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