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Conformity of Intellectual Development and Constructivism Textbooks of Science-Based Physics

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Abstract: Most students need help understanding physics material, especially Newton's laws. This is due to the thought that physics material is complex and requires memorizing formulas. This study aims to make it easier for students to understand physics material through Scientific-Based Textbooks. The research method uses research and development, which is used to create teaching material products and test product effectiveness. This study uses four stages: defining, designing, developing, and disseminating. The results showed that the teaching materials made in the form of textbooks were valid according to the results of the validation instruments that the validator had validated. The validator instruments include the eligibility of textbooks in the form of material, presentation systematics, language, contextual aspects, accessibility, navigation, communication, display quality, and the overall function of the media. The results of the percentage of validators related to the language feasibility of the Physics Textbook show the average rate by the two validators, namely 88.3% and 85%. The resulting percentage is feasible because the validity coefficient is > 85%. These results indicate that the Scientific Based Physics Textbook can be used after revision.

Keywords: Constructivism; Intellectual; Physics; Science-Based

Introduction

Teaching materials are a device that contains learning materials for achieving the expected goals (Asmara, S. et al., 2020). Teaching materials must be designed by building students' knowledge through what students see and read. With teaching materials, students can study material without the help of educators and can find a concept from material that has been read in teaching materials. From this statement, it is necessary to design teaching materials to help students find concepts from the material (Maiyena, S., et al., 2020). The independent curriculum emphasizes students playing an active role and teachers playing a passive role in learning, so a scientific approach is needed to foster positive responses and improve students' critical thinking. Through a scientific approach, it is expected to achieve competency in the curriculum. One of them can improve students' critical thinking so they can complete a project (Ulandari, F., et al. 2018). The scientific approach, in which students play an active role in learning, raises the high quality of science learning outcomes, especially in physics. (Jannah, M., 2019).

In globalization, intellectual development plays a significant role in forming quality Human Resources (HR). Intellectual development can be formed from small to large. This intellectual development is one of the capital to continue higher education equipped with sufficient skills and knowledge. Every child has different intellectual development, so educators can adjust the character of each student to develop their intelligence

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(Putriana, S. et al, 2021). Intellectual development is related to the potential of the human brain, which is related to how to gain knowledge from the environment, changes in abilities and patterns of thinking and proficiency in the language. The process of intellectual development in children is like putting together several words into sentences, solving problems, observing what is happening in the environment and telling parents or those closest to them about the experiences they get (Oktavia, S. A., 2021:127).

Constructivism is a theory that states that students' understanding is based on how they acquire and shape knowledge naturally through experiences and interactions that are experienced (Yunita. L., et al, 2021). The advantages of constructivism theory in school learning include training students independently, thinking critically, creatively, and innovatively to establish collaboration between students. Based on the process that has been passed, constructivism theory is considered capable of expanding students' cognitive development and providing support for conducive learning process conditions. There are several ways to maximize the application of an approach with constructivism theory, including educators being able to motivate students to learn to develop critical thinking skills, understand concepts by comparing events in everyday life, and carry out learning activities by integrating scientific methods (Agustia, L. dan L. Dwiridal, 2019).

The scientific approach, known in the 2013 curriculum, embodies constructivism theory. The scientific approach is the 5M (observing, asking, trying, reasoning, and communicating (Risma, M., et al, 2019). (Kemendikbud, 2014) The scientific approach to learning consists of five main learning experiences: observing, asking, gathering information, associating, and communicating. Learning with a scientific approach is a learning process designed in such a way that students actively construct concepts, laws, or principles through stages of learning that involve process skills such as observing, classifying, measuring, predicting, explaining, and concluding. The scientific approach has several characteristics, including student centers (student-centred), carrying out learning activities by integrating science process skills in constructing concepts, involving cognitive processes with higher-level thinking to stimulate students' cognitive development, and being able to develop student character (Putri, I et al. 2020).

Physics is a natural science that discusses natural phenomena and phenomena. In physics, students must understand the material, principles, concepts, theories and laws, requiring a scientific attitude and critical thinking. In addition, a rational, empirical and systematic logical attitude is also needed. Students can also carry out the learning process in the classroom and the classroom. outside the classroom because physics is a science concerned with nature (Maiyena, S., et al. 2020) In learning physics, there is material about Newton's laws of motion. As the basis of classical mechanics developed by Newton, Newton's laws are classified into three types. First, the law is related to the inertial nature of objects (Newton's first law). Second, the law discusses the relationship between acceleration and mass, and force on objects (Newton's second law). Third, the law that discusses the relationship between action and reaction forces (Newton's third law) (Asmara, S., et al, 2020).

The process of learning physics is required to improve student learning outcomes so that students produce value in psychomotor, cognitive, and affective aspects. Increased learning outcomes in physics can be generated by fighting spirit and critical thinking skills. Fighting power is a person's ability to carry out business actions to move his determination to the maximum and overcome all problems or difficulties to achieve specific goals has characteristics that do not give up easily, is not easily satisfied, and keep trying until desired. While critical is a person's ability to analyze or solve an idea or ideas in a homologous, systematic, productive way to help evaluate and make decisions according to his beliefs so that he can solve or successfully solve a problem. The relationship between fighting power and critical thinking is very close to solving problems. Applying a problem-based learning model must pay attention to the allocation and the right time to produce the maximum learning process and minimize student misconceptions. In the learning process, students must seek information in advance and conduct investigations and discussions (Wibowo, T. B. S. 2021) From this background, we need teaching material with a scientific approach in accordance with intellectual development and constructivism.

Method

The research model used is research and development using research and development to create teaching material products and test product effectiveness (Istiqomah et al., 2021). The development of textbooks becomes more meaningful because the material is well presented, fun, innovative and confident. So students' interest in learning is increasing, and every learning student may be able to think critically, communicate, collaborate, and have creativity and character (Kurniawan et al., 2021). The research or scientific method is a procedure or step in obtaining scientific knowledge. So the research method is a systematic way of compiling knowledge. At the same time, research techniques are ways to carry out research methods. Research methods usually refer to forms of research. These systematic steps include: (1) Identifying

and formulating problems, (2) Developing a framework for thinking, (3) Formulating hypotheses, (4) Testing hypotheses, and (5) Concluding. In other words, the scientific method is obtaining and compiling knowledge (Suryana, 2010:1).

In this study, four stages were used, namely defining, designing, developing, and disseminating. Textbook development begins with analysing the curriculum, students, and the material to be delivered. Textbooks are designed based on a scientific approach. Furthermore, the textbooks are evaluated by experts in their fields. The material and design of the textbooks that have been prepared will be given input as improvements to the book. However, due to time constraints, this research did not reach the distribution of textbooks to others (Setiyadi, 2017).

Textbook development begins with validity, which means the accuracy of the test in measuring something that must be measured. Gronlund generally defines validity as the extent to which test results can be used for the intended purpose. In other words, validity is the suitability of interpreting the test results. Validity is the level of reliability and validity of the measuring instrument used. The instrument is said to be valid, meaning that the instrument used to obtain data is valid or can be used to measure what should be measured (Yolanda and Wahyuni, 2022).

$$V_{a_n} = \frac{TS_e}{TS_h} \times 100\% \quad (1)$$

$$V = \frac{V_{a_n}}{n} = \cdots \% \quad (2)$$

The data analysis in this study uses a percentage-based calculation that will be classified according to the textbook validity criteria. The first step is to find the average result of each validator's assessment. To calculate this, the researcher can use the following formula 1, where TSeTS_e represents the total empirical score (the validation results from the validator) and TShTS_h is the maximum expected total score. This formula provides the expert validity for each individual validator's assessment.

Next, to calculate the joint validity, the researcher must first determine the value of each validity test. Once these individual values are known, the combined validity of the analysis results can be calculated using the following formula 2, where n is the number of validators involved. This calculation will yield the combined validity, which reflects the overall consensus from all validators in the study.

Table 1. Validation categories

Validity criteria	Validity level
85,01%-100,00%	Very valid or can be used without revision
70,01%-85,00%	Quite valid or can be used but needs a little revision
50,01%-70,00%	Less valid and not used because it needs major revisions
1,00%-50,00%	Invalid or may not be used

Result and Discussion

A physics textbook based on scientific Newton's law of motion is carried out to know the validity of the textbook. Various analyses do the validity process. Material analysis was carried out to determine the type of scientific approach to Newton's law material based on core competencies (KI) and essential competencies (KD) in the curriculum. Task analysis and assessment are conducted to obtain information regarding students' understanding and knowledge of Newton's laws in applying the knowledge and media they have received.

Figure 1. General Cover and Book Contents

Validation activities were carried out by providing the results of draft guidelines, physics textbooks based on Newton's laws of motion and instrument sheets in the form of validation sheets by two validators. The validation results will provide the feasibility and practicality of developing scientific-based textbooks in the learning process. The average percentage of eligibility textbooks based on scientific physics Newton's law of motion.

Table 2 shows the validation results of the two validators regarding the feasibility of Newton's Law of Motion Scientific-Based Physics Textbook in the very feasible category because the resulting validity coefficient is >85% and the internal coefficient is also the same. As for the suggestions given by the validator regarding revision, namely the title of the proposed textbook and several designs in the book's contents. Meanwhile, the material contained in the textbook meets the criteria and deserves to be called a textbook.

Table 2. Average Percentage of Eligibility Textbooks on Scientific-Based Physics Newton's Laws of Motion

Validator	Eligibility Criteria	Average (%)
Validator I	Valid can be used after revision, meaning valid	88.3
Validator II	Valid can be used after revision, meaning valid	85.0

Table 3. Average Percentage of Accessibility, Navigation, Communication, Display Quality, and Overall Function of the Media contained in the Scientific-Based Physics Textbook Newton's Laws of Motion.

Validator	Eligibility Criteria	Average (%)
Validator I	Very valid can be used after revision means valid	90.0
Validator II	Very valid can be used after revision means valid	91.6

Based on the validation of material expert one and material expert two on the language component, the suitability of the development of students in this textbook is given a score of 4, which means that the language used is very appropriate to the intellectual level of students. Language suitability is critical because using appropriate language can make it easier for students to understand the textbook. Appropriate language, namely the use of language in media that is presented correctly and in accordance with Indonesian language rules (EYD). With the appropriate language, the information in the textbook is conveyed and does not cause ambiguity. Besides that, the appropriate language can motivate students to learn so that students easily understand the material. Language is an important component in making textbooks because language is a tool for students to understand textbooks. So that textbooks are made using communicative language, which is easy for students to understand. In addition, the presentation of textbooks must be coherent from start to finish and accurate in typing, such as terms and spelling, which must match Enhanced Spelling (EYD).

Based on the validation results of the two validators regarding the contextual aspects contained in the Legal Scientific-Based Physics Textbook, Newton's Motion fits the criteria as a textbook. As for the sub-assessment of the contextual aspect, namely the linkage of material with everyday life so that students can connect the material taught in everyday life, and the material contained in textbooks is constructive or builds knowledge so that students do not only receive knowledge

Table 3 shows the validation results of the two validators related to Accessibility, Navigation, Communication, Display Quality, and Overall Media Functions contained in the Textbook of Physics-Based on Scientific Newton's Laws of Motion. The results of the average percentage show that the textbooks made are in the very feasible category because the validity coefficient produced is > 85%, and the internal coefficients are the same as for the suggestions given by the validator regarding revision, namely to be better at connecting the linkages of the methods used with the contents of the book material, image quality, and the attractiveness of textbooks to students.

In the validation criteria that have been carried out, the aspects of accessibility and navigation contained in the book are included in the perfect category. As for the sub-assessment in the aspects of accessibility and navigation, namely, students can easily operate the textbook according to the method used. In the aspect of communication and display quality, the validated assessment includes communication or the goals desired by the author according to what is targeted, the balance of composition between images and other objects can increase students' interest in the learning process, and display design in the form of writing style, color, and clarity textbook when used. Regarding the overall function of the media, the validation criteria are in the form of students' collaboration skills so that they are intrigued and motivated to seek more content in them, and textbook media can be easily used.

Scientific-based physics textbooks are useful for adding information and learning media, so they are expected to increase knowledge. Teaching materials contribute a lot to learning media and are easier to obtain and become the main media. from the research results, the level of understanding of reading content is easy to understand because this teaching material is made so that students can be motivated to use it. As explained above, the level of eligibility criteria is perfect. Concepts that affect the ease of understanding are quite feasible in making students interested in reading. Appropriateness that is relevant/accurate also meets students' level of understanding. Understanding of the material is obtained if the readability level of the book read is appropriate and easy to interpret. This teaching material has considered the material being taught to be adequate and help students master basic competencies. therefore this teaching material is designed not too little and not too much in the presentation of the material so that it can help achieve learning competencies and not waste time and effort that does not need to be studied.

The textbooks focus on understanding concepts that are hard to imagine becoming easier to understand. With the proper absorption of physics concepts, students will get high motivation to achieve their goals. Feedback or responses from educators to students will

be used as an evaluation material and have varied learning models for achieving learning success. The design of this textbook is very appropriate in the presentation of material because it provides more complete additional information. Therefore, textbooks can assist educators in achieving learning competencies, not wasting time and energy to stay focused on the material being taught. So that students can be involved in making interactive learning.

Conclusion

Based on the research results, scientific-based physics textbooks are feasible because the resulting validity coefficient >85% is the same as the internal coefficient. Adjustment of the language used in textbooks according to the development of students. So that students can understand Newton's law material well and relate to the material taught in everyday life through structured textbooks.

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Author Contributions
Ridha Amalila Choir and Siti Ike Nur Jannah Tiara contributed to the conceptualization of this research, with Ridha Amalila Choir also responsible for the development of the methodology and the software utilized. The validation process was jointly conducted by Ridha Amalila Choir and Siti Ike Nur Jannah Tiara, while the formal analysis was exclusively performed by Ridha Amalila Choir. During the investigation phase, Ridha Amalila Choir, Siti Ike Nur Jannah Tiara, and Moza Oriana Rahmadinanti collaborated in data collection and analysis. This research was supported by resources provided by I Ketut Mahardika, who facilitated the necessary infrastructure and assistance. The research data were curated by Ridha Amalila Choir and Siti Ike Nur Jannah Tiara to ensure accuracy and integrity. The initial draft was prepared by Ridha Amalila Choir, whereas the review and editing processes were carried out by Moza Oriana Rahmadinanti, Adinda Nina Eka Sakti, and Rany Angeline Yulianto. For data visualization, Amallia Rizky and Moh. Dimas Feri Hermansyah were responsible for systematically and effectively presenting the findings.

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The authors declare no conflict of interest.

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