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Validity and Reliability of Physics Learning Devices Based on Guided Inquiry to Improve Students' Creative Thinking Skills

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Abstract— This study aims to develop guided inquiry-based physics learning devices to enhance students' creative thinking skills. The development model used is the 4D model (Define, Design, Develop, and Disseminate) developed by Thiagarajan, Semmel, and Semmel. The learning devices developed include teaching modules, learning materials, student worksheets (LKPD), and evaluation instruments. The validity and reliability of the devices were analyzed through assessments by six validators, consisting of three expert lecturers and three practicing teachers. The validation results indicated that all developed learning devices fall into the "highly valid" category, with average scores ranging from 3.32 to 3.71. The validity covered aspects of content and construct. Meanwhile, the reliability test was carried out using the Borich method, with a percentage of agreement criterion of ≥ 75%. The analysis results showed that all learning devices had reliability levels above 88%, thus categorized as reliable. It can therefore be concluded that the guided inquiry-based physics learning devices developed are feasible to be used in learning activities to facilitate and enhance students' creative thinking skills.

Keywords— Development; Learning Devices; Guided Inquiry; Creative Thinking Skills.
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1. Introduction

The development of the times, marked by technological advancement and the complexity of global issues, demands an education system that produces a generation not only academically intelligent but also equipped with higher-order thinking skills, particularly creative thinking. Creative thinking encompasses the ability to generate multiple ideas, produce diverse and original ideas, and elaborate and refine them. This ability is an essential component of 21st-century skills that students must possess to face global challenges [1].

Physics, as a fundamental branch of science, plays a strategic role in training logical, systematic, and creative thinking skills. Meaningful physics learning is not limited to the transfer of concepts but also encourages students to explore, solve problems, and construct their own knowledge. Physics learning becomes more meaningful when students are actively involved in observing, understanding, and utilizing natural phenomena in their surroundings [2]. The importance of this study lies in its contribution to providing a concrete solution to the problem of low creative thinking skills among students through the innovation of applicable and relevant learning tools. Furthermore, the results of this study are expected to serve as a reference for physics teachers in implementing active, exploratory, and problem-based learning. Consequently, students will not only gain a deep understanding of physics concepts but also develop the creative thinking skills needed to tackle future challenges.

However, field observations show that physics teaching in schools is still dominated by traditional teacher-centered approaches. Learning methods that prioritize lectures and memorization hinder students' ability to think critically and creatively [3]. This is supported by the researcher's observations at SMAN 1 Gerung, which revealed that learning tools such as syllabi, lesson plans, worksheets, and media used are still conventional and not designed to promote active student participation in creative thinking.

Creative thinking skills are part of higher-order thinking skills (HOTS), which include the abilities to analyze, evaluate, and create. Learning that supports HOTS development must be able to encourage students to think divergently and solve problems creatively. However, many classroom learning activities still emphasize knowledge acquisition without stimulating students to create or generate alternative solutions to problems [4]. To address this issue, a learning model that actively engages students in the thinking process is necessary. The guided inquiry model is a relevant approach, as it allows students to directly experience the process of scientific thinking with teacher guidance. Guided inquiry positions students as the main actors in the learning process through investigative stages—from problem formulation to drawing conclusions [5].

Previous studies have shown that the guided inquiry model is effective in enhancing students' creative thinking abilities. However, its implementation in schools remains limited due to the lack of systematically developed learning tools based on this model [6,7]. Therefore, the development of guided inquiry-based physics learning tools is crucial. These tools include teaching

modules, learning materials, student worksheets (LKPD), and evaluation instruments that are designed in alignment with creative thinking indicators such as fluency, flexibility, originality, and elaboration [1]. Properly designed learning tools can enhance the quality of teaching and learning processes as well as students' learning outcomes [8]. Based on this urgency, this study aims to develop guided inquiry-based physics learning tools to improve students' creative thinking skills, particularly on the topic of elasticity and Hooke's Law, as a contribution to improving the quality of physics education in senior high schools.

2. Research Methods

This study employed a Research and Development (R&D) method. The research design used is the 4D development model, which consists of four stages: (1) Define; (2) Design; (3) Develop; and (4) Disseminate. However, this study was limited to the third stage, namely the Develop stage. This means that the development process included the preparation of learning tools, validation by experts (validators), and revisions based on suggestions and feedback from the validation results. The Disseminate stage was not conducted in this study, considering that the primary focus was to produce theoretically valid learning tools before being tested on a broader scale [9].

In the Define stage, an analysis was conducted. This stage involved five main steps: Preliminary Analysis, Learner Analysis, Task Analysis, Concept Analysis, and Specification of Learning Objectives. Next, in the Design stage, a draft of the problem-based learning tools was created. This stage included three steps: media selection, format selection, and the initial design of the learning tools. Then, the Develop stage aimed to produce and validate the learning tools, including teaching modules, learning materials, student worksheets (LKPD), and evaluation instruments. Product validation is an activity to assess the product design, intended to minimize errors in the development stage.

3. Research Results and Discussion

Validity of Learning Devices

The validity test was conducted by six validators, consisting of three expert validators who are lecturers in Physics Education at the Faculty of Teacher Training and Education, University of Mataram, and three practitioner validators who are physics teachers at SMAN 1 Gerung.

Table 1. Expert Validation Results of Learning Devices

Aspect	Expert Validators			Total Score	Average Score	Category
	VD1	VD2	VD3			
Teaching Module	2,70	3,80	3,60	10,10	3,36	Very valid
Teaching Materials	3,00	3,71	3,57	10,28	3,42	Valid
Student Worksheet (LKPD)	2,77	3,66	2,44	8,87	2,95	Very valid
Creative Thinking Test	2,38	3,62	3,62	9,62	3,20	Very valid
Overall Average					3,32	Valid

Table 2. Practitioner Validation Results of Learning Devices

Aspect	Expert Validators			Total Score	Average Score	Category
	VG1	VG2	VG3			
Teaching Module	3,50	3,70	3,70	10,90	3,63	Very valid
Teaching Materials	3,71	3,85	4,00	11,56	3,85	Very valid
Student Worksheet (LKPD)	3,77	3,22	4,00	10,99	3,66	Very valid
Creative Thinking Test	3,87	3,25	4,00	11,12	3,70	Very valid
Overall Average					3,71	Very valid

- **Validity of the Teaching Module**

The teaching module or instructional material is one of the essential learning tools that contains systematically arranged content used by both teachers and students during the learning process. With the availability of teaching materials, the learning process becomes more efficient, as teachers do not need to deliver the entire content in front of the class, and students are also supported in their learning [10]. The teaching materials developed by the researcher focus on the topic of elasticity for Grade XI of senior high school. Several components are included in the teaching material: cover, problem presentation, content and concepts accompanied by images, sample questions, and practice exercises. These components were validated by both expert and practitioner validators.

Based on the Likert scale calculation shown in Tables 1 and 2, the validation conducted by expert and practitioner validators yielded average scores of 3,32 and 3,71, respectively. These scores fall into the "strongly agree" category, indicating that the developed physics teaching module based on guided inquiry is categorized as valid. This validity is supported by the module's systematic structure, alignment with basic competencies—which assists teachers in achieving specific learning objectives—the availability of illustrative images to help students understand the material, and the use of clear, comprehensible language.

The developed teaching module is a collection of content systematically organized and sourced from various learning references, designed according to the indicators to achieve the intended learning objectives. This finding is in line with previous studies, which state that instructional materials intended to determine the success of the learning process must be systematically designed and aligned with the curriculum and relevant indicators. As a result, the validators rated each aspect of the module with a "very good" category, indicating that it is suitable for use in the learning process [11].

In addition, other research shows that the guided inquiry model has proven effective in enhancing students' creative thinking

skills. The learning outcomes of students in the affective domain during three sessions of guided inquiry-based learning reached 82,31%, which falls into the "very good" category. Nevertheless, the developed module still requires improvements based on suggestions and comments from both expert and practitioner validators. One such recommendation is that the module should better facilitate the development of creative thinking skills [6,7,12].

- **Validity of Teaching Materials**

Teaching materials refer to content or resources that are systematically organized and used by both students and teachers during the learning process. The teaching materials developed by the researcher consist of subject content that includes examples of real-life applications of the concepts, along with explanations of the relevant theoretical concepts. Based on Tables 1 and 2, the average validation scores for the teaching materials by expert validators and practitioner validators were 3,32 and 3,71, respectively. These scores fall into the "strongly agree" category, indicating that the teaching materials developed by the researcher are considered valid. This validity is attributed to the fact that the materials include applications of physics concepts in everyday life, are aligned with the learning outcomes (Capaian Pembelajaran or CP), and thereby assist teachers in achieving specific instructional goals. In addition, the images included in the teaching materials are clearly presented, which contributed to the validators' assessments in the "good" and "fairly good" categories for those aspects, resulting in an overall classification of the materials as valid.

- **Validity of Student Worksheet (LKPD)**

Student worksheets (LKPD) are sheets that contain experimental or discussion activities to be carried out by students [13]. LKPD can also be defined as a set of fundamental activities that students must engage in to maximize their understanding and develop basic competencies aligned with the achievement indicators [3]. LKPD serves as a tool that supports and facilitates the teaching and learning process in the classroom, enables effective interaction between students and teachers, and enhances student engagement and academic achievement [14]. The use of LKPD also encourages students to become actively involved in the learning process by training them to identify and solve problems independently. Through the knowledge and skills acquired, students do not simply recall facts or events but instead construct concepts on their own, which positively influences their learning outcomes [15].

The LKPD developed in this study was designed to facilitate and train students in developing their creative thinking skills. The worksheets were organized for three learning sessions, each presenting real-life problems related to the concept of elasticity. Additionally, they included a project-based experiment that students had never performed before. These practical activities were carried out in groups of five students under the guidance and supervision of the teacher. Through these hands-on experiments, students were expected to enhance their problem-solving and reasoning skills, actively engage in the learning process, and gain a deeper understanding of the physics concepts being studied. Direct experimentation also offers the advantage of familiarizing students with actual laboratory equipment, allowing them to explore the tools themselves.

Based on the Likert scale calculations presented in Tables 1 and 2, the LKPD validation results from expert and practitioner validators yielded average scores of 3.32 and 3.71, respectively. These scores fall into the "strongly agree" category, indicating that the developed LKPD is considered valid. This is attributed to the LKPD's appealing design, clearly presented identity information, the inclusion of images and illustrations, well-structured observation tables, and thought-provoking questions related to the experiments that stimulate creative thinking. Additionally, the language used in the LKPD adheres to standard grammar rules (in accordance with EYD) and employs simple, understandable sentence structures, which aid students in following instructions and answering the questions provided. These findings are consistent with previous studies indicating that LKPD developed using an inquiry model is feasible and falls into the valid category, making it suitable for developing students' creative thinking skills [16].

The LKPD is deemed valid as it meets both content and construct validity criteria. Content validity is achieved as the activities in the LKPD align with and fulfill essential learning components, effectively facilitating students' creative thinking development. Construct validity is met due to the coherence and consistency between the title, objectives, and student activities. Moreover, the use of standard and easily comprehensible language further supports students in completing tasks and understanding the questions presented in the LKPD.

- **Validity of the Creative Thinking Skills Test Instrument**

A test instrument is a tool used to measure the achievement of learning competencies and to assess the extent of students' acquired abilities. The test instrument developed in this study consists of 8 essay-type questions aligned with indicators of creative thinking skills. There are four indicators of creative thinking—fluency, flexibility, originality, and elaboration—with each indicator represented by two items. The same set of test items was administered to students before and after the implementation of the guided inquiry-based learning tools, with the aim of identifying any improvement in students' creative thinking skills in physics.

Based on the Likert scale calculations presented in Tables 1 and 2, the validation results by expert and practitioner validators showed average scores of 3.32 and 3.71, respectively. These scores fall under the "strongly agree" category, indicating that the instrument is valid. This validity is attributed to several factors: the test includes clearly stated question titles and student identification fields, the instructions are easy to understand, the purpose of each question is clear, the items align with creative thinking indicators, and the language used is simple and comprehensible for students.

Previous research has similarly shown that creative thinking skill test instruments fall within the valid category based on expert judgment. This is because the test items were appropriately matched to creative thinking indicators, making the instrument suitable for classroom use [17]. Validators also agreed that the developed test instrument meets the indicators of creative thinking and can effectively train students in enhancing their abilities. Furthermore, the validity of the instrument is supported by both content and construct validity. Content validity is achieved as the problems presented are consistent with the teaching materials and the creative

thinking indicators. Construct validity is met due to the alignment of the test problems with competency achievement indicators.

Reliability of Learning Devices

In addition to validity testing by expert and practitioner validators, the developed learning devices were also subjected to a reliability test. Reliability testing is conducted to ensure that the tools or products consistently measure what they are intended to measure [18]. In line with this, the reliability test is used to determine the consistency of the instrument and to assess whether it is dependable and maintains consistency during repeated measurements. An instrument is considered reliable if it can be trusted as a measurement tool and consistently produces stable results [19].

The reliability of the learning devices in this study was analyzed using the Borich method, which calculates the percentage of agreement (PA) to determine the level of agreement among validators. A learning device is considered reliable if the PA score is ≥ 75% [20]. The learning devices assessed for reliability included the syllabus, lesson plans (RPP), physics teaching modules, student worksheets (LKPD), and the creative thinking skill test instrument.

Table 3. Average Percentage of Agreement (PA) of Learning Devices

Learning Device	PA (%)	Kategori
Teaching Module	90,05	Reliabel
Teaching Materials	94,22	Reliabel
Student Worksheet (LKPD)	90,62	Reliabel
Creative Thinking Test	88,21	Reliabel

Based on Table 3, the average reliability scores obtained from both expert and practitioner validators are as follows: 92.9% for the teaching module, 94.22% for the teaching materials, 90.62% for the LKPD, and 88.21% for the creative thinking skills test instrument. According to the Borich method, all of these percentages exceed the 75% threshold, indicating that all developed learning devices are reliable. This means that the learning tools can be trusted and are consistent in measuring what they are intended to measure. Based on the explanation of both the validity and reliability of the developed learning devices, it can be concluded that the guided inquiry-based physics learning tools are valid and reliable, and therefore suitable for use in classroom learning.

4. Conclusion

Based on the results of the research and discussion, it can be concluded that the guided inquiry-based physics learning devices developed have met the criteria for validity. The validity test results showed average scores of 3,32 and 3,71, which fall into the "valid" category, while the reliability test results showed percentages of 92,9% for the teaching module, 94,22% for the teaching materials, 90,62% for the student worksheet (LKPD), and 88,21% for the creative thinking skills test instrument—all of which fall into the "highly reliable" category. Thus, the developed learning devices are feasible to be used in further trial stages. It is recommended that the guided inquiry-based physics learning devices be further tested in a limited classroom trial. Such trials are necessary to determine the practicality and effectiveness of the devices in enhancing students' creative thinking skills. In addition, the development of similar devices can also be carried out for different topics or educational levels to enrich the variety of innovative learning resources aligned with the Merdeka Curriculum.

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