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Physical Module Validation Integrating Creative Thinking Ability in Measurement and Movement Materials

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ABSTRACT

In response to global demands, a Physics module intertwining creative thinking ability was developed. Using a 4D model, the research progressed through defining, designing, developing, and disseminating stages. The module aimed at high school class X students and underwent comprehensive analysis, creative infusion, crafting, validation, and packaging. Data collection utilized a Likert scale-based questionnaire, with experts determining validity within predefined ranges. The resultant Physics module scored 71 for validity, harmonizing with science principles and class X suitability. It aligned with prior research, demonstrated creative thinking feasibility (average score: 65%), and nested within the valid range. This research demonstrated the profound significance of structured research and development methods. Future exploration includes classroom impact assessment, diverse instructional designs, technology integration, cross-disciplinary investigations, and qualitative methods like interviews to capture student narratives.

Keywords:*Module, Creative Thingking Ability*

I. INTRODUCTION

During the 4.0 revolution, it was hoped that students would be able to change the nature and attitudes of students and be able to hone and develop student abilities. During the 4.0 revolution it was not enough just to have basic education (reading, writing and arithmetic) but it was necessary to understand literacy during the 4.0 revolution, especially data literacy with the ability to study, analyze and utilize data in the digital era. Usually especially in understanding with Permendikbud Number 21 2016 and KD from Permendikbud Number 24 of 2016, one of the essential educational goals that must be developed is the ability to think creatively. Creative thinking is a high level thinking process that is rarely done. In learning physics, creative thinking can be said to still receive less attention [1]. The study assesses how integrating metacognitive education, influenced by learning theory, enhances short-term creative ability development, highlighting the role of metacognition in nurturing innovative thinking [2].

Imaginative thinking can be a tendency to think sharply with instinct, mobilize creative energy, reveal conceivable modern results, uncover amazing thoughts and motivate unexpected thoughts [3]. Creative thinking refers to students' ability to form and create thoughts for problems and alternative solutions [4]. Creative thinking is a thinking process characterized by fluency, flexibility, originality, and originality [5].

The current condition shows that students' creative thinking ability are still low. The results of the research in class XI Temanggung in the initial cycle got an average score of 5.87 consisting of an average score of fluency aspects of 1.83, Dexterity 1.37, Authenticity 1.33 and Elaboration 1.33. The creative thinking intelligence of class XI students in the initial cycle got an average score of 3,933 with the highest score of 5. It can be concluded that the percentage obtained is 29.3% [6]. So it can be said that the ability to think creatively is still low. The ability to think creatively is said to be low if the percentage is <40%.

Curriculum revision is one of the efforts made by the government in order to achieve national education goals. A good curriculum has a very important role in directing student learning and development. Curriculum revision is an important effort to continue to present learning that is more adaptive, responsive and relevant to the demands of the times. By ensuring that the curriculum reflects the latest developments in education and the world, governments contribute to achieving broader national education goals. The 2013 curriculum replaces the

Education Unit Level Curriculum (KTSP). The 2013 curriculum provides solutions to the problems faced by education in the twenty-first century. As previously mentioned, the 21st century is a century based on knowledge and technology. Creative Indonesian children are expected to be produced by the 2013 curriculum [7].

The prevalent practice of students solving problems by adhering to teacher-provided solutions has led to a diminished capacity for creative thinking. The tendency of students to depend on these solutions and perceive a sole correct approach to resolving physics-related issues poses a significant obstacle to cultivating creative thinking and proficient problem-solving ability. To mitigate this concern, educators can adopt measures such as promoting a diversified problem-solving ethos, integrating open-ended questions, and encouraging students to explore innovative solutions. By countering the inclination toward rigid solutions, educators can stimulate creative thinking, enhancing students' problem-solving acumen and enabling them to approach challenges with greater ingenuity. However, there are several steps that teachers can take to overcome this problem, namely (1) When introducing a new concept or way of solving a physics problem, present several different approaches. This gives students an understanding that there are various ways to achieve the same goal, (2) Create a group discussion session where students can share the various solutions they have found. This not only broadens students' perspectives, but also teaches them about variations in thinking, (3) Give assignments that require creative thinking and problem solving. Give space for students to develop their own solutions without following the guidelines that have been given, (4) Focus on the problemsolving process rather than just the final result. Teach students how they can design their own steps to solve a particular problem. (5) Ask questions that encourage deep thought, for example, "Is there another way to look at this problem?" or "How can we take a different approach?", (6) Hold collaborative sessions or team projects that encourage students to learn from each other's approaches. This collaboration can produce a variety of ideas and strategies, (7) Provide real problems from the real world that involve solving physics problems. This will help students see how the concepts taught can be applied in everyday life situations, (8) Invite students to create their own problem-solving challenges based on the physics concepts they have learned. It encourages creativity and application of their understanding, and (9) Provides supportive feedback when students try new approaches. This will give them the confidence to experiment further.

Creative thinking should be embedded in the learning process. To anticipate and react effectively to the uncertainties of today's changing world conditions, creative people are needed. Physics teachers believe that creativity is not required to study physics and only basic logic is required. However, a physicist who creates new solutions or results must not neglect his creative potential [8].

The teacher's efforts as a motivator and facilitator in increasing students' competence in thinking ability are very important in creating a learning environment that stimulates creativity and problem solving. Using interesting textbooks is a good way to help students understand the material better. With a combination of efforts as a motivator, facilitator, and the use of various interactive learning methods, teachers can help students develop strong creative thinking ability and prepare them to face challenges in the real world. However, this has not been able to encourage students to optimally improve their creative thinking abilities. Based on [9] regarding an analysis of two Physics textbooks which are widely used in schools throughout West Sumatra, it was obtained that the average value of each book was that book A was worth 31.55 and book B was worth 37 with the less available category. As shown in Table 1.

Table 1. Analysis of Physics Textbooks

No Books	Subject Matter	Creative Thinking Indicator				Average
		Fluency	Flexibility	Originality	Elaboration	
A	Material 1	62,5	16,67	16,67	14,29	**31,55**
	Material 2	75	50	16,67	28,57	
	Material 3	62,25	16,67	33,33	14,29	
	Material 4	50	16,67	16,67	14,29	
B	Material 1	87,75	16,67	33,33	28,57	**37**
	Material 2	75	33,33	16,67	14,29	
	Material 3	62,5	33,33	16,67	14,29	

Material 4	75	33,33	33,33	14,29

In line with research [10] regarding the analysis of the availability of creative thinking abilities in the presentation of two high school textbooks that are widely used in schools, the results obtained were that the average value obtained from the analysis of these textbooks was less than 40% with the category less available so that books existing ones have not facilitated the ability to think creatively.

So textbooks used for learning in schools are not ideal in encouraging the improvement of students' creative thinking ability. Creative thinking ability are needed by students to solve a problem in various problems. Moreover, seeing the current educational challenges that demand the birth of a superior generation. Students need to be equipped with learning support tools in order to foster creative thinking. One of them has a module that integrates creative thinking built into it.

If the learning process utilizes various available facilities and infrastructure, including using various learning resources, then the learning process will be successful. All materials that help students learn are referred to as learning resources. Currently, various learning resources are used, including people, libraries, books, media, and museums [11]. Many learning resources, including locations, objects, people, books, events, and facts, can be used as teaching tools in the classroom. If it is not laid out in such a way that it is possible to use it as teaching material, it will not function as a useful learning resource for students and teachers [12]. In order for the teaching and learning process to be carried out properly, it is important for teachers to continue to create teaching materials to support learning. Improving teaching materials is very important for teachers so that learning is more active, capable, and does not deviate from the competencies to be achieved [13]. One of the developments referred to is the development of modules. The modules referred to here are modules that integrate the ability to think creatively that students are expected to be able to improve their ability to think creatively.

In the modern era, because learning physics must relate physics learning material to everyday life, this is an important step in facilitating students to think creatively. This helps students see the relevance of physics concepts in a more real context and encourages them to think more creatively about how physics can be applied in everyday situations. Relating physics with everyday life will not only increase students' understanding but will also encourage them to think creatively about how to apply knowledge in a wider range of situations. One of the materials that can make students think creatively is measurement and motion, because many events can be related to everyday life. Measurement and motion are two materials that can inspire students to think creatively because they relate to many real-world events.

In connection with the development of modules that encourage creative thinking ability, the same research has been carried out, including: [14], [15], [16]. Several previous studies were different from this research but both developed modules. The difference lies in the material being studied. Where in this study the researchers conducted research with the title "Physics Module Development Integrating Creative Thinking Ability on Measurement and Motion Materials"

II. METHOD

Research and Development (R&D) is a research category that is in line with the problems and objectives that have been described. Research and development methods, also known as R&D in English, are research techniques used to create a particular product, innovation or solution and assess its feasibility and effectiveness. [17]. This study employs a structured 4D model, comprising four interconnected stages: defining (Define), planning (design), development (develop), and spread (disseminate).

In the defining Stage, the process commences by identifying and detailing the fundamental prerequisites crucial for subsequent development, encompassing materials, samples, and product design essentials.

The subsequent planning stage revolves around constructing an innovative learning module plan.

The development stage involves crafting modules and test questions, followed by validation and evaluation to gauge the feasibility of the product design. Expert evaluations guide adjustments to ensure alignment with objectives and client needs. During the learning device development stage, it is possible that some modifications need to be made to ensure that the resulting product achieves the actual goals or targets that have been set. The validation testing phase is an important step to identify whether the product is in accordance with its original purpose and whether further adjustments are needed. To assess the effectiveness of the product being developed, measurement of goal attainment is also carried out at this stage. To avoid repeating errors when the product is distributed, researchers or developers should review the results of implementing their objectives and describe any solutions that did not work.

The concluding dissemination stagesignifies the culmination of the 4D model, focusing on often overlooked yet critical aspects such as packaging, diffusion, and adoption [18].

Weighting is done based on the Likert scale. The variables to be measured are divided into dimensions which are further divided into sub-variables, then these sub-variables are further broken down into indicators that can be measured using a Likert scale. Then created questions that must be answered by respondents. Each reply is associated with a form of question or attitude support which is communicated as follows.
5 marks for very good answer.
4 points for good answer.
3 points for sufficient answer.
Weight 2 for less answer.
Weight 1 for the answer is very less.

The scoring process involves assigning points to respondents based on their answers. To calculate the score for each respondent, the assigned points are summed up. This sum is then divided by the highest possible score (represented by the sum of all weights) and multiplied by 100. This calculation determines the numerical value corresponding to each statement within the questionnaire's different categories. In this context, the chosen range of values lies between 1 and 100, with 100 being the maximum achievable value. This process can be expressed mathematically as follows:

$$Score = \frac{Total\ Weight}{Maximum\ Weight} \times 100 \tag{1}$$

The product validity value is obtained through a validation test instrument, namely in the form of a validity test sheet containing assessment indicators. This instrument is filled by experts. The validity assessment is determined based on the score interpretation criteria obtained. Assessment criteria can be determined using a Likert scale. In this study, the validity value is classified in the range of 61 to 100.The criteria used to determine validity are in Table 2.

Table 2. Validation Criteria

Mark	Criteria
0 – 20	Invalid
21 – 40	Less valid
41 – 60	Pretty valid
61 – 80	Valid
81 – 100	Very valid

(Source : [19])

Table 2 presents the Validation Criteria, outlining various score ranges that define the levels of data validity. Scores within the range of 0 to 20 signal that the data is labeled as "Invalid." Scores spanning from 21 to 40 indicate a lower level of validity, characterized as "Less Valid." Data falling within the 41 to 60 range is considered to possess a moderate level of validity, referred to as "Pretty Valid." Scores between 61 and 80 signify data that is classified as "Valid," and if the data's scores range from 81 to 100, it attains the highest level of validity, referred to as "Very Valid." By utilizing these clearly defined criteria, one can evaluate the data's validity based on its score range, aligning with the context of the research or analysis undertaken.

III. RESULTS AND DISCUSSION

The validation process for the physics module, which incorporates creative thinking ability, involves the assessment of its creative thinking component by experts. These validation results are obtained through the evaluation conducted by experts. The purpose of this validation by experts is to ascertain the module's feasibility and to provide guidance for any necessary revisions to the product. In this process, the module is subjected to validation by a panel of three expert lecturers and one teacher. The evaluation involves assigning scores to questions, ranging from a minimum of 1 to a maximum of 4. Subsequently, the results of this validation process for the physics module, focusing on the integration of creative thinking ability within the context of measurement and motion, will be presented.

The Physics module's validity assessment instrument is designed to incorporate creative thinking ability within the context of measurement and motion topics. The evaluation of the developed product's validity or feasibility is conducted through the examination of five distinct assessment components. These components include content feasibility, construction feasibility, language feasibility, module display feasibility, and the feasibility of the creative thinking component.The initial component, content feasibility, is comprised of five indicators that assess various aspects of the module's content. The scores assigned to each indicator are used to analyze the feasibility of the content. These content feasibility indicator scores are visually represented in Figure 1, providing a clear overview of the assessment outcomes.

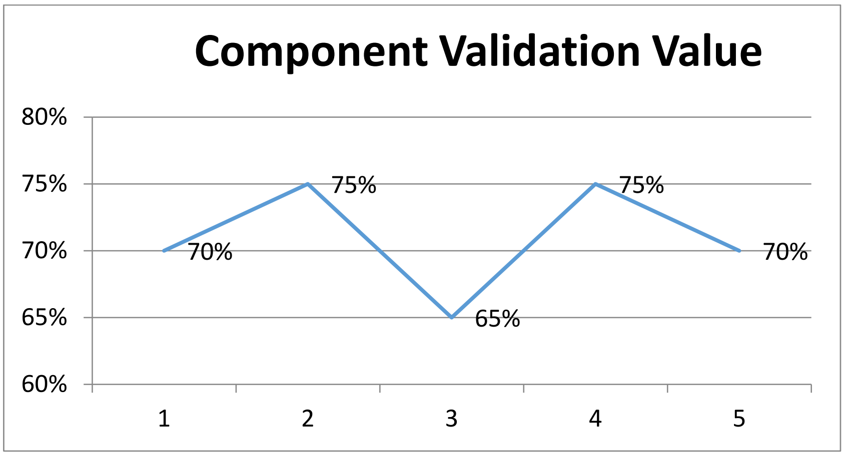

Figure 1. Content Service Component Validation Value

The value of each indicator of the content feasibility component can be explained in Figure 1. The indicators for this component consist of: (1) learning modules made according to the syllabus; (2) The substance of the learning module is appropriate; (3) Learning modules are based on current issues; (4) Submission of ideas/materials is appropriate in the learning module; (5) Learning modules improve understanding and turn it into information.
Based on the value of the five indicators, an average content feasibility assessment component was obtained, namely 73%. Thus, the material substance eligibility component is included in the valid category.

The second component is construction feasibility, there are six indicators. The plotted values of the construction feasibility indicators are shown in Figure 2.

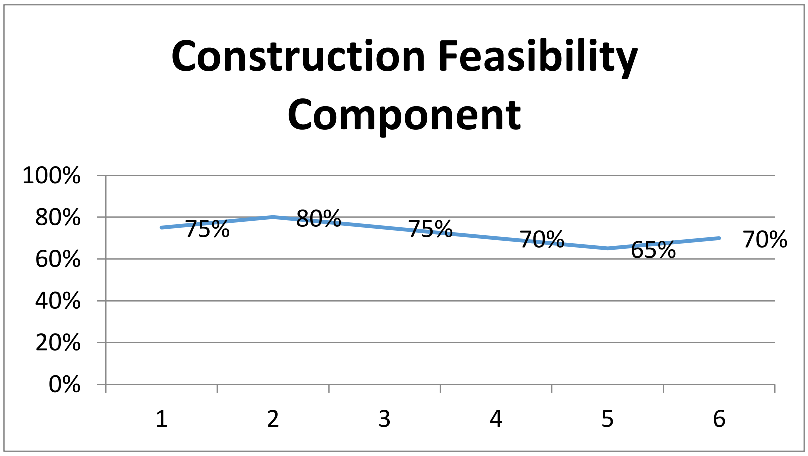

Figure 2.Validation Value on Construction Feasibility Components

The value of each indicator of the construction feasibility component can be explained in Figure 2. The indicators for this component consist of: (1) Structure of writing an effective learning module; (2) the arrangement of learning modules is appropriate; (3) module goals are well defined; (4) The information displayed is useful; (5) encouragement and reaction (interactivity) in the learning module is clear; (6) The data presented in the learning module is comprehensive. Based on the values of the six indicators, an average construction feasibility assessment component is obtained, namely 73%. Thus, the material substance eligibility component is in the valid category.

The third component, namely language feasibility, consists of five indicators. The plotted values of the language eligibility indicators are shown in Figure 3.

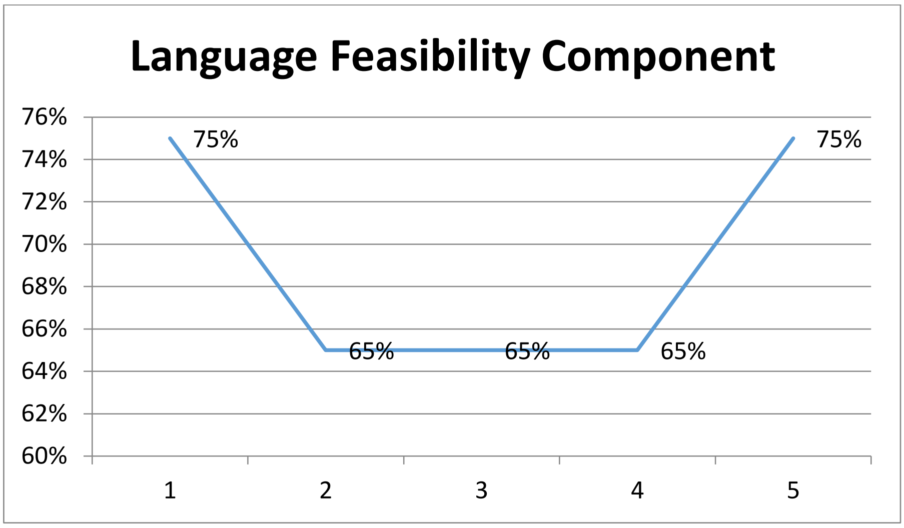

Figure 3. Validation Value of the Language Feasibility Component

The language feasibility component's indicators, as depicted in Figure 3, encompass five aspects: (1) Clarity and ease of understanding of sentences in the learning module; (2) Appropriate linkage between paragraphs in the module; (3) Proper usage of accentuation within the learning module; (4) Correct use of conjunctions in the module; and (5) Well-executed arrangement of titles and subtitles in the learning materials. Upon evaluating the values assigned to these five indicators, the average score for the language feasibility assessment component was determined to be 69%. This score places the language feasibility component within the valid category, indicating that the linguistic aspects of the module are effectively designed and align with the intended criteria.

The fourth component is the feasibility of the display module consisting of five indicators. The plotted value of the module display feasibility indicator is shown in Figure 4.

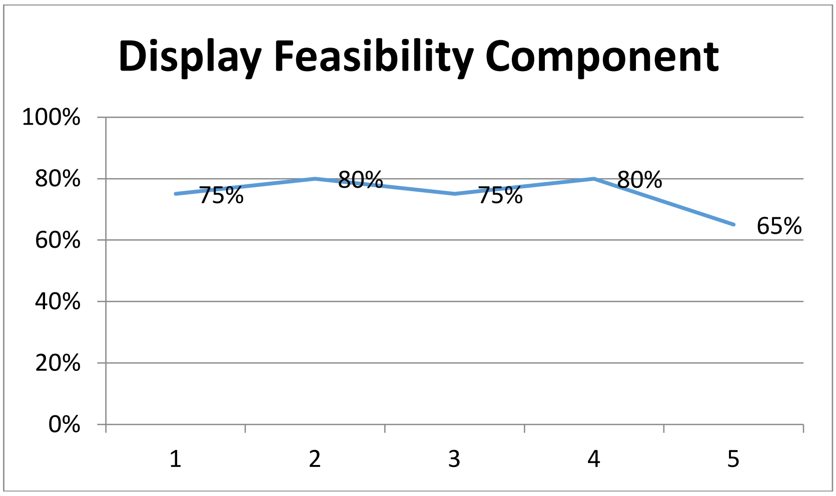

Figure 4.Validation Value on Module Display Feasibility Components

The feasibility component pertaining to the module's display, as illustrated in Figure 4, comprises five distinct indicators: (1) The initial visual appeal of the learning module; (2) The well-designed format of titles and subtitles within the lesson; (3) The appropriateness and engaging nature of the text style's type and size in the learning module; (4) The intriguing format used for cover pages and transitions between sections in the module; and (5) The captivating arrangement of outlines, pictures, and designs integrated throughout the learning module. By evaluating the assigned values for these five indicators, the resultant average score for the feasibility assessment of the module's display is computed as 75%. This score positions the module's visual presentation within the valid category, affirming that the module's design and layout are effectively implemented and align with the desired criteria.

The fifth component is feasibility*creative thinking* there are four indicators. Plotted values of feasibility indicators*creative thinking* shown in Figure 5 below.

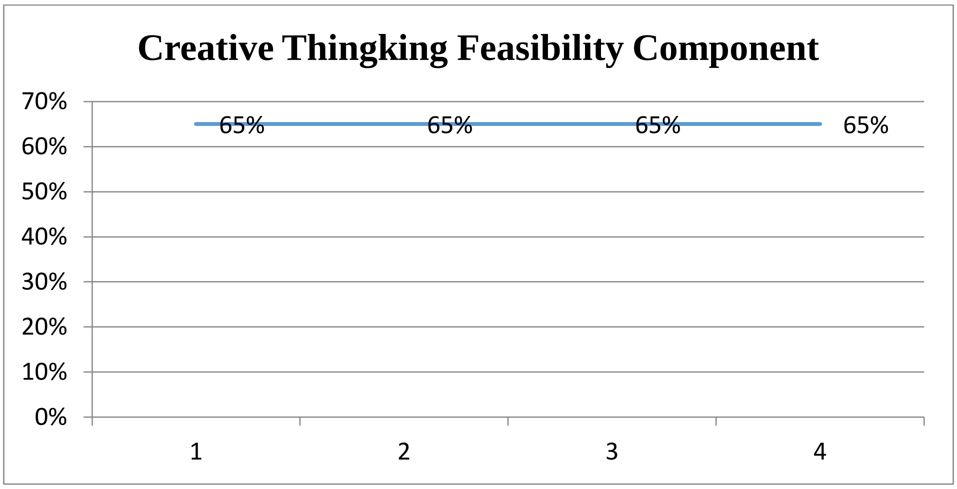

Figure 5.Validation Value on Creative Thinking Feasibility Components

The feasibility component pertaining to creative thinking, as elucidated in Figure 5, encompasses four distinct indicators: (1) Guiding students in effectively communicating diverse thoughts regarding problems (fluency); (2) Guiding students in generating a variety of ideas for problem-solving or answering questions (flexibility); (3) Guiding students in producing novel ideas for problem-solving (originality); and (4) Guiding students in enhancing the quality of an idea through addition, organization, or elaboration (elaboration). By analyzing the assigned values for these four indicators, the resultant average score for the feasibility assessment of creative thinking is computed as 65%. This score places the creative thinking component within the valid category, indicating that the module effectively incorporates elements that foster fluency, flexibility, originality, and elaboration in students' thinking processes.

The validation results from the Physics module integrating creative thinking abilities according to experts are valid with a validity value of 71. This value is in the range of 61 to 80 with a valid category.This module has a high validity value because the substance of the material is complete and in accordance with scientific principles.The validity assessment outcome indicates that certain components of the assessment are not flawless. The results of the validation process, combined with feedback from the validator on the validation sheet, highlight the need for revisions in the final product. These findings underscore the importance of refining the product based on expert input to enhance its quality and alignment with desired standards.Thus, the Physics module integrates the ability to think creatively in measurement and motion material suitable for use in class X physics learning. As is the opinion [20] which reveals that expert validator input in the validation process is in the form of suggestions, criticisms and corrections that reach the referencefor repairs and improvements.These results are in accordance with [21]which argues that a learning tool can be declared valid if experts assess the development of the device to be consistent between each aspect assessed, where each component of the device has a relationshipone another.

This statement illustrates that the research being carried out has the support of several previous research journals that have the same theme.These research journals are a source of reference and guidance in writing ongoing research.They were chosen because they have a close relationship with the current research topic, so that the information contained in these journals can be used to strengthen and guide the research being carried out.

The findings demonstrate the feasibility of the creative thinking component in the Physics module, elucidated in Figure 5. This component encompasses indicators such as guiding students in problem communication (fluency), diverse idea generation (flexibility), introduction of novel ideas (originality), and refining ideas for quality enhancement (elaboration). The average assessment score for creative thinking feasibility is 65%, categorizing it as valid. Moreover, the Physics module's integration of creative thinking is validated with a score of 71, falling within the valid range (61-80) due to comprehensive material alignment and adherence to scientific principles. The validation results, similar to [19], underline expert feedback's role in refining and enhancing the product. This echoes [20], highlighting consistency and interconnectedness among aspects for valid learning tool development.

In the context of prior research, this study draws parallels with the work titled "*Contextual-Based Module Validation Test Integrating Creative Thinking Ability in Static Fluid Materials, Temperature, and Heat in Class*

XI SMA/MA" conducted by [22]. The outcome of their investigation revealed the validity of a module incorporating creative thinking ability, utilizing the R&D method with the ADDIE model. Focusing solely on Static Fluid Material, Temperature, and Heat, the developed physics module achieved a validity score of 84.80, categorizing it as valid for enhancing students' creative thinking within physics education. Similarly, another study titled "*Validity of Physics Module Integrating Creative Thinking Ability in Momentum and Impulse Materials*" by [23]. employing the R&D method with the ADDIE model, concentrated on Momentum and Impulse Material. The resulting physics module garnered a validity score of 89, classified as very valid for promoting creative thinking skills in physics education. An additional journal article titled "*Effectiveness of Edmodo to Improve Senior High School Students' Creative Thinking Skills in Momentum and Impulse Topics*" explores the efficacy of Edmodo, an online learning platform, in fostering creative thinking in momentum and impulse topics [24]. Furthermore, the journal article "*Development of Impulse and Momentum Teaching Materials Using the Inquiry-Discovery Learning Model to Train Students' Creativity*" focuses on cultivating creative thinking through teaching materials employing the inquiry-discovery learning model [25]. Lastly, the article "Analysis of Momentum and Impulse on Students' Creative Thinking Skill through Project-Based Learning Integrated STEM (Science, Technology, Engineering, Mathematics)" delves into enhancing creative thinking through project-based learning integrated with STEM [26]. These studies collectively illuminate instructional strategies for nurturing creative thinking ability within the domains of momentum and impulse in physics education.

In this study, trying to provide novelty from these previous studies. If you look at previous research, the method used is R&D with the ADDIE model while researchers use the R&D method with the 4D model. The problem that was examined by previous researchers was the development of a module that integrates creative thinking skills on Static, Temperature and Heat, Momentum and Impulse materials.At the moment researchers are developing modules integrating creative thinking skills in Measurement and Motion material.

IV. CONCLUSION

The Physics module integrates creative thinking ability into the topic of measurement and motion that has been developed and obtains a validity score of 71 which is included in the valid category based on research findings and discussions conducted. This shows that the Physics module which combines creative thinking ability meets the valid requirements. The validation process of the Physics module integrating creative thinking ability in measurement and motion materials has confirmed its validity through various assessment components. The alignment with scientific principles and suitability for class X physics learning is evident from validation scores and expert insights, reinforcing its significance and resonance with prior studies. For future research, exploring real classroom impact, different instructional design models, technology integration, and cross-disciplinary applications are recommended. Additionally, incorporating qualitative methods like interviews can provide deeper insights into student experiences, enhancing research outcomes.Furthermore, the inclusion of qualitative data collection methods, such as interviews or focus groups, can provide deeper insights into students' perceptions and experiences with the integrated module, thereby enriching the overall research outcomes.

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