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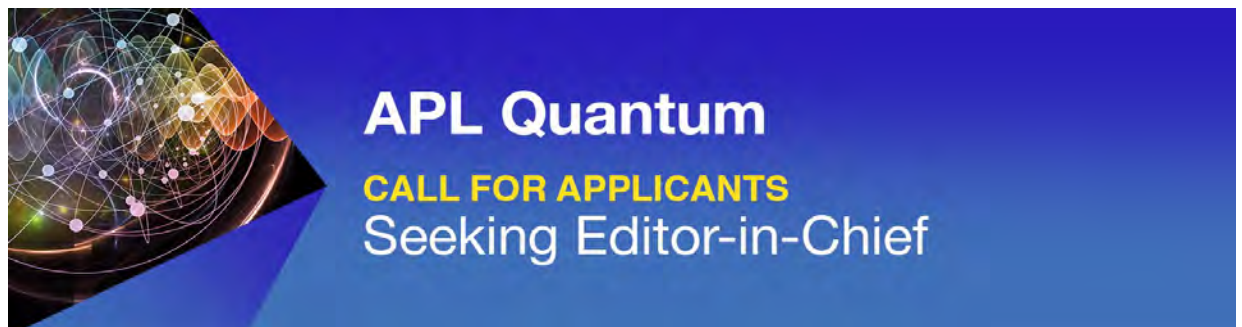
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Development of Creative Thinking Skills Test Instruments on Kinematics Materials for SMA/MA Students in Medan

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Abstract. The purpose of this study was to determine the characteristics of creative thinking skills test on kinematics material. Research participants were students of class X SMA Al Azhar Medan and class X students of MAN 1 Medan who had received kinematics material. The type of research used is research and development (R&D). The research carried out refers to product development in the form of a creative thinking skill test instrument. Before the test instrument for creative thinking skills was tested on students, the test was validated first. The product development subjects consist of content or material experts, instrument experts, and linguists. The data analysis technique used in this research is descriptive analysis technique. From the results of small group and large group trials, 22 test instruments on kinematics material were declared valid. The conclusion obtained after the research is the characteristics of the creative thinking skills test instrument developed were declared valid with high interpretation, reliable with very high interpretation, and the level of difficulty and discriminatory power was classified as good; the research participants' creative thinking skills were quite adequate.

INTRODUCTION

In the era of the industrial revolution 4.0, Indonesia requires human resources who are able to think creatively and critically to produce individuals who have sharp analysis, make appropriate decisions and can produce innovative work. At the beginning of the 21st century, creativity is needed and continues to increase in every field of human activity [1]. In order to face changes in aspects of life that take place very quickly in this globalization era, people must be able to think creatively, be able to act quickly and precisely, be able to solve problems effectively, and be able to adapt to changes that occur [2]. Creative thinking skills are very important for a person to have in order to foster smooth and flexible idea-giving thinking, be able to review problems from various points of view, and be able to come up with original and unique ideas [3]. Based on the results of research by the GCI (Global Creativity Index) 2015, Indonesia is in the 115th position out of 139 participating countries with a global creativity index of 0.202. In ASEAN, Indonesia is ranked 6th out of 6 countries that are the object of analysis. This shows that the creativity of the Indonesian people is still low. Meanwhile, in facing future challenges, apart from relying on a conscious and literate attitude towards technology, creative thinking skills are also very necessary [4].

Creative thinking skills are a person's ability to generate ideas, have different points of view, are imaginative, skilled in expanding and solving problems [5]. Creative thinking requires both parts of the brain, namely the balance between logic and intuition which is very important. If someone has the ability to think creatively, then they can solve problems in real life in a variety of possible ways that they can do. According to Guilford, creativity or creative thinking as the ability to see various possible solutions to a problem, is a form of thinking that until now has received less attention in formal education [6]. The results of a national survey of education in Indonesia show that the formal education system in Indonesia in general still does not provide opportunities for the development of creativity [7].

In education, to find out the creative thinking skills possessed by students, an evaluation needs to be carried out. One of the evaluations in education can use tests that function to provide information about certain aspects [8]. In addition to getting information about a person's creative thinking skills, the use of tests can also improve creative

thinking skills. But in general, the tests used in schools only include assignments that must find one correct answer, so that students' creative thinking skills cannot be measured significantly [9]. In learning physics in SMA/MA, students are required to achieve maximum learning goals in terms of developing skills to understand conceptual and creative thinking by studying every problem that occurs in life using appropriate physics concepts [10-11]. Meanwhile, with the right learning objectives adapted to the problems that occur in life, it is necessary to develop in terms of assessing student skills. One of the evaluation instruments used to measure each skill possessed is by using a test [12-13].

Evaluation instruments such as test instruments must be developed with careful planning to measure higher order thinking skills, namely creative thinking [14]. Creative thinking skills are basically skills that arise because they often solve problems using different ways [15]. Therefore, one of the efforts that need to be made to improve creative thinking skills is to often practice solving a physics problem in life. Research related to the development of students' creative thinking skills in learning has not been widely studied. Likewise, the development of creative thinking skills tests has not been widely carried out [16]. Based on the description of the background above, the authors need to develop a test instrument that is valid, reliable, has good discriminating power, and has a good level of difficulty.

METHODS

The research was carried out in schools, where the selected schools had implemented an online learning system using the Zoom and Google Meet applications for virtual face-to-face meetings. The selected schools have implemented the revised 2013 curriculum and have an accreditation, namely MAN 1 Medan and Al Azhar High School Medan. The time of the research was carried out in the 2020/2021 Academic Year semester II. Research on the development of creative thinking skills instruments for kinematics material will be carried out online (online) and the product development concept used by researchers is the concept of research and development.

The concept used is the development of Analysis, Design, Development, Implement and Evaluation (ADDIE) by Robert Maribe Branc, namely, analyze, design, develop, implement, and evaluate. The analyze (analysis) stage includes information gathering consisting of the methods used, field observations, selection of physics material, qualification of the materials developed, preparation of making creative thinking skills test instruments and product assessment literature studies. The design stage includes the design of scoring guidelines and the design of creative thinking skills test instruments. The develop stage includes expert validation of the creative thinking skills test instrument. The implementation stage is testing the creative thinking skills test instrument in schools. The evaluation stage is the analysis and evaluation of the validation results obtained in the field. For data processing analysis using the help of the ANATES program.

RESULT AND DISCUSSION

Analyze

The analysis stage is the initial stage of development research. At this stage, information was collected by using interviews with subject teachers to see the characteristics of students, teaching and learning processes and student learning outcomes. Based on the results of interviews with teachers in the field of physics, it is known that the average character of class X MAN 1 Medan and class X Regular SMA Al Azhar Medan has an interest in learning in the medium category. It is still rare for teachers to use creative thinking skills tests which causes students to be less able to develop creative thinking skills and students are also still accustomed to working on procedural questions, causing students to find more answers than finding many ways/answers to solve a problem related to the problem. Physics concept. After the analysis stage is carried out at the research site, the next stage is to design a test instrument for creative thinking skills and design quality criteria for the question instrument.

Design

At the design stage, namely designing a test instrument for creative thinking skills on kinematics material by making a grid of questions that refers to indicators of achievement of learning competencies. The grid is a table containing the specifications of the test items that will be made as a reference for the authors, so that whoever writes

them will produce test items with relatively the same content and level of difficulty. The next stage after making a question grid is to make scoring guidelines and assessment designs for creative thinking skills instruments on kinematics material, then the author designs the criteria for the quality of the question instruments. These criteria are needed as a reference to determine the quality of the instrument questions that have been designed are good or not. Then the criteria for the test instrument were compiled, including:

1. The criteria for the content of the questions are said to be good if the test instrument has a validity calculation result (≥ 0.60)
2. The reliability criteria are said to be good if the test instrument has a degree of reliability (> 0.70).
3. The criteria for the level of difficulty (difficulty) are said to be good if the test instrument has a level of difficulty (0.31-0.70).
4. The criterion for discriminating power is said to be good if the test instrument has sufficient discriminatory power (≥ 0.30).

The stage of designing the test instrument for creative thinking skills on kinematics material has been completed. The following is the scoring guideline for the creative thinking skills test instrument which is written in table 1.

TABLE 1. Assessment guide for creative thinking skills test instrument on kinematics material

Indicator	Assessment
Fluency	Score 0: did not answer at all the questions given Score 1: Able to make a mind map to support the answer to the given problem Score 2: Able to make a mind map, and provide several answers in answering questions
Flexibility	Score 0: did not answer at all the questions given Score 1: Able to give opinion/interpretation of an image/story/problem Score 2: Able to provide an opinion/interpretation of a picture/story/problem and explain the concept of motion to solve the given problem. Score 3: Able to provide an opinion/interpretation of an image/story/problem, provides a concept of motion to solve a given problem and is able to provide several considerations/different and appropriate ways to solve a given problem.
Originality	Score 0: did not answer at all the questions given Score 1: Able to give birth to new ideas / ideas to solve the given problem Score 2: Able to give birth to new ideas / ideas to solve the given problem and able to combine two different ways to solve different problems Score 3: Able to generate new ideas/ideas to solve the given problem and able to combine two different ways to solve different problems, and generate imaginative ideas to design something in the future
Elaboration	Score 0: did not answer at all the questions given Score 1: Able to write detailed objectives of the experimental design made Score 2: Able to write down the purpose of the experimental design made and able to provide appropriate experimental procedures and details of the designed experiment Score 3: Able to write down the purpose of the experimental design made and able to provide experimental procedures that are equipped with experimental sketches designed

Development

At the development stage, the authors conducted instrument validity about creative thinking skills on kinematics material. The purpose of validity is to obtain information, criticism, and suggestions so that the creative thinking skills

test instrument developed becomes a quality product in terms of material, construction and linguistic aspects. The instrument validity was carried out by three experts. Based on expert review, the instrument developed was categorized as valid with revision. Suggestions given by several experts include: questions must be adjusted to indicators of creative thinking skills, and the use of sentences must be effective and easily understood by readers. Changes in questions before and after revision can be seen in table 2 below.

TABLE 2. Changes in questions before and after revision

Questions before revision	Questions after revision
Describe some advantages and disadvantages if a car has a maximum speed of only 60 km/hour. Make the answer in the form of a mind map? (fluency)	To minimize the occurrence of accidents on the highway, the government issued a regulation of the Minister of transportation no. 111 of 2015 concerning the setting of the highest speed limit for urban areas ranging from 50 km/hour. From the above statement, in addition to reducing accidents in urban areas, describe some other advantages if a vehicle, the maximum speed is only limited to 50 km/hour? Make the answer in the form of a mind map (fluency)

Implementation

The implementation phase is the testing phase of the instrument about creative thinking skills on kinematics material. The questions will be tested in large groups involving 40 participants who have previously received teaching on kinematics material. The purpose of the test test is to find out the characteristics of the questions that have been designed, namely validity, reliability, discriminatory power and level of difficulty of the questions.

Empirical Validity Analysis

Empirical Validity is used to determine whether the questions can be said to be valid (appropriate to use) or invalid (not feasible to use). From the test results obtained 22 valid questions and 3 invalid questions, the average value of r count items is 0.62. This means that the average test instrument for creative thinking skills has valid criteria with a high category. The distribution of the 22 items based on validity is in Figure 1.

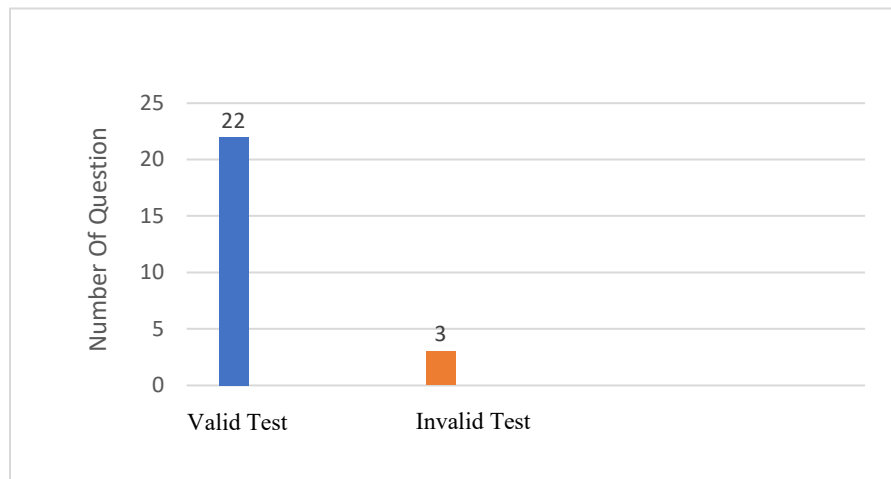


FIGURE. 1. Test Instrument Validity Results

Reliability Analysis

Reliability refers to the consistency or stability of the assessment results. From the results of the reliability test obtained using the assistance of the ANATES program, the test reliability results were 0.95, so that the test instrument was categorized as having "Very High" reliability.

Discriminatory Power Analysis

The purpose of discriminatory power is to distinguish between high-ability test takers and low-ability test takers. Of the 22 valid questions, there are 13 questions with good discriminating power category, 4 questions with sufficient category and 5 questions with bad category. Because there are 6 questions in the bad category, then 5 questions must be revised first. Overall, the average value of the differentiating power of creative thinking skills test has a value of 0.40 which is classified as good category. The results of the analysis of the discriminatory power of the questions can be seen in Figure 2 below.

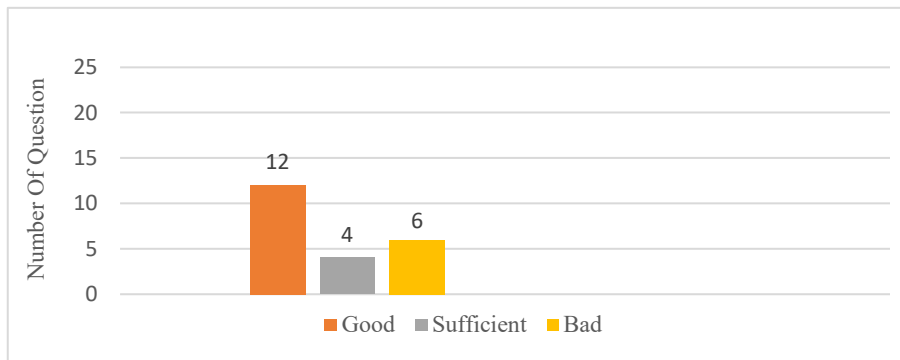


FIGURE 2. Results of Calculation of Discriminatory Power of Questions from Large Group Trials

Difficulty Analysis

That a good question is a question that is not too easy and not too difficult, therefore, it can be stated that a good question is a question with a moderate level of difficulty [17]. Based on the analysis of valid question data, obtained 14 questions in the medium category, and 8 questions in the easy category. The results of the difficulty level analysis are presented in Figure 3.

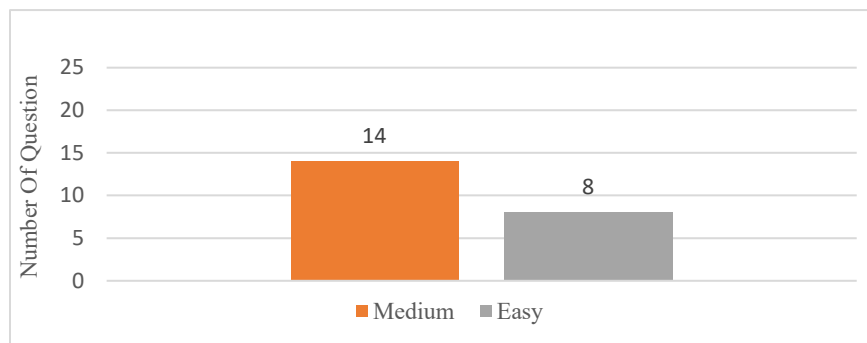


FIGURE 3. The Result of the Calculation of the Difficulty of the Questions from the Large Group Trials

Evaluation

The evaluation process is carried out to find out questions that can be said to be valid and analyze the answers of research participants. Based on the test results, there are 22 questions that are declared valid. The results of identification and analysis of students' answers can be concluded that the mastery of students' creative thinking skills on kinematics material still needs to be improved. Improving students' creative thinking skills can be done by creating appropriate learning to be able to facilitate students to find many ways and can find new ideas to solve contextual problems and increase their conceptual knowledge on kinematics material.

Results of Quality Analysis of Creative Thinking Skills Test Instruments

Based on the results obtained from the data analysis of validity, reliability, discriminatory power and level of difficulty, the criteria for the developed test instrument were produced. This criterion is needed to determine the quality of the test instrument that has been developed is good or not. The results of the analysis of the quality of the creative thinking skills test instrument are:

1. The criteria for the content of the items are classified as good because the calculation of the average value of validity is 0.60.
2. The test reliability criteria are classified as good because the test instrument has an average reliability value of > 0.70 .
3. The criteria for the level of difficulty of the questions are classified as good because the test instrument has a difficulty level value (0.31 0.70).
4. The criteria for discriminating power of questions are classified as good because the test instrument has a discriminatory value (> 0.30).

From the four criteria, the creative thinking skills test instrument developed has a good quality instrument.

Development of Creative Thinking Skills Test Instruments to Develop Students' Creative Thinking Skills

Students' creative thinking skills based on the analysis results obtained the average creative thinking skills of students in the small group test is 61.59 with sufficient category, while the average value of students' creative thinking skills in the large group test is 65.75 with sufficient category. The average results obtained by students are good, but further efforts are still needed by the teacher so that they can provide more frequent questions that can spur students' creative thinking skills to become very good (very creative). The creative thinking skill instrument that has been developed is valid and reliable and meets the criteria for a good test, it will be able to measure students' creative thinking skills. This result is also strengthened by research which shows that to measure the creativity of physics students, standard instruments are used and are useful for developing physics-specific instruments, while also increasing creativity through direct instruction [18]. The measurement of creativity in students can be seen from the score of fluent thinking ability (number of ideas or answers), elaboration thinking ability (number of details on answers or ideas), flexible thinking ability (number of categories or different ideas).), and original thinking skills (number of unique ideas judged by experts or by statistical tabulation) [19].

From the results of the study, it is known that the percentage of achievement of the fluency indicator is the highest value compared to other indicators. This means that in general students are able to generate many ideas, answers, problem solving, provide many ways or suggestions for doing many things and are able to make mind maps. On the percentage of achievement of the original thinking indicator, the lowest percentage was obtained compared to other indicators. This shows that students have not been able to maximally generate new ideas/ideas to solve the given problem, combine 2 different ways to solve the given problem and produce imaginative ideas to design something in the future. This is in line with research conducted in terms of developing a creative thinking skill test instrument where the lowest indicator results are obtained on the indicator of original thinking in planning new things, the low level of original thinking of students in the research area can be caused by the dominant students working on questions that are procedural in nature so that students are less skilled in solving problems whose nature demands to get something novelty [20].

In the percentage of achievement indicators of flexible thinking and elaboration, the percentage obtained with sufficient categories shows that students are able to express their opinions on a problem, students are able to express what physics concepts are used to solve a problem both in general and in general. Contextually and physically, students are quite able to use different ways to solve a problem. and students are able to provide a detailed explanation of the

experimental design or practicum related to kinematics material. This can be seen from the category that is classified as sufficient for the two indicators of creative thinking.

The use of test instruments as an assessment for learning is needed to develop students' thinking skills. This is in line with research [21]. The results obtained indicate that assessment for learning, the process of identifying learning development, is able to develop students' thinking skills. Thus, the use of creative thinking skills test instrument as an assessment for learning is able to develop students' thinking skills.

Contribution of Creative Thinking Skills Instrument to the Learning Process

The 2013 curriculum targets to increase the creativity of students as optimally as possible so that they are able to innovate to answer increasingly complex future challenges, this is in line with the statement which states that to prepare quality human resources, education must focus on a training process that focuses on innovation and creativity [22].

In learning physics in SMA/MA, students are required to achieve maximum learning goals in terms of developing skills, to understand conceptually and think creatively by studying every problem that occurs in life using appropriate physics concepts. In addition, creative thinking skills are needed in an effort to solve a problem.

Problem solving is done by using the knowledge and skills possessed to answer unanswered problems or facing difficult situations, for that researchers design and create instruments for creative thinking skills on kinematics material in SMA/MA, so that students are skilled in solving contextual problems related to motion. Such as students are invited to find various ways to minimize accidents on toll roads, on circular roads, and students are also invited to find the benefits of learning a concept of motion in everyday life.

It is hoped that the existence of a creative thinking skill test instrument on kinematics material makes learning more innovative and meaningful for students so that students are more skilled in creative thinking. Creativity will make life more beautiful and varied. People who are not creative and always do activities with certain routines will quickly feel bored and unmotivated. While people who do creative things will make life more varied so that they are always excited because they find something new, besides being skilled in creative thinking, students are expected to be able to face the Industrial Revolution 4.0, and skilled in facing increasingly fierce global competition in the 21st century.

CONCLUSION

Based on the results and discussion, the creative thinking skill test instrument on the kinematics material developed can be declared valid, reliable, has good discriminating power, and has a good level of difficulty.

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