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PROFILE OF COMBINATORIAL REASONING ABILITY USING DESCRIPTION TESTS IN PHYSICS LEARNING OF HIGH SCHOOL STUDENTS

Feby Dwi Cahyanti[a)], Yetti Supriyati[b)], Anggara Budi Susila[c)]

Department of Physics Education, Faculty of Mathematics and Natural Sciences, Jakarta State University, Indonesia

Email: [a)]dc.feby@gmail.com, [b)] yetti.supriyati@unj.ac.id, [c)] anggorobs1960@yahoo.com

Abstrak

This study aims to describe the combinatorial reasoning ability of high school students in physics learning and determine the characteristics and instrument quality of combinatorial reasoning using the written test. The research method used is Analyze Design Development Implementation and Evaluation (ADDIE). The written test has the characteristics to measure the ability of deductive hypothesis between variables, to determine the process of combining student reasoning in solving the sequence and series problems and using all possible alternative answers in solving a problem systematically based on the combinatorial stage reasoning. The combinatorial reasoning test was validated by expert and physics teachers. The research participants are a student in six high school grade eleven who had learned all of the concepts in one term. The research results show the combinatorial reasoning ability of high school students that 24% of students had a high level of combinatorial reasoning; in this case, the students can fulfill the combinatorial stages. 64% of students were in the medium category, and 10.83% were in a low category.

INTRODUCTION

Reasoning ability is very important in building intelligence thinking on all disciplines and as a key to effective learning [1]. The development aspects of the reasoning in the learning process are very important because the reasoning is the activity of abstract thinking that can support the understanding of physics [2]. Students will always interact and engage with their peers and teachers who have different abilities, perspectives,and attitudes during the learning process. Therefore, students must have the character of tolerance so that they can respect their peers and teachers. [3].

Students are formed to have the competence to develop reasoning skills inductively and deductively [4] to analyze using concepts and principles in physics that explain natural events and problem-solving qualitatively and quantitatively [5]. Students solve problems by solving problems by expressing appropriate arguments to solve the solution [6]. Argued that this argument is also included in the level of thinking ability. It can even fall into the category of higher-order thinking [7].

To determine the achievement of learning goals, which in this case is the development of reasoning students, it takes assessment as an integral component of learning. Assessment is a systematic activity process to collect information about the learning process and student learning outcomes to make decisions about students [8]. Assessment of reasoning requires different instruments and methods from assessing how students learn and acquire knowledge [9]. Piaget's reasoning identifies four stages of developing reasoning skills, namely sensory operations,

preoperational, concrete operations and formal operations [10]. Baker explained that formal reasoning is the ability of students to perform formal operations including: proportional reasoning, variable control, correlation reasoning and combinatorial reasoning [11]. Piaget applies the problem presentation the method that provides some of the information needed so that students focus on tests of ability to use and processing information [9]. In this case one part of formal reasoning is combinatorial reasoning, namely the deductive reasoning ability of hypotheses that operates by combining and evaluating the possibilities in each situation.

The combinatorial reasoning process requires the generation of element combinations in certain situations. Combinatorial reasoning represents a structured whole of formal reasoning [12]. Combinatorial is described as the art of calculating all the possibilities or ways in which a given number of objects can be combined to ensure that there is no loss of possible results in solving problems [12]. Students are not only asked to acquire knowledge but apply knowledge In solving the problem based on all the possibilities that you have [9]. Combinatorial reasoning is the process of forming complex constructs based on a given set of elements that fulfill the conditions explicitly given or concluded

Based on the results of tests conducted by TIMSS on Indonesian students, Indonesia is in a low category. This is due to the ability of students who have the ability to know but are not accustomed to solving application and reasoning problems [13]. In addition, students are not accustomed to knowing correctly the desired questions because the representation of questions requires student reasoning. This is as expressed by Kohl that the success of students in solving problems is influenced by the format of the representation of the questions given [14]. Research conducted to determine students' reasoning abilities has been carried out because of the application of assessment as learning that has been developed to support learning [13]. One of which is combinatorial reasoning which can be said to be still in the low category in learning physics [2]. Besides research that is conducted to develop essay questions with an approach showing that combinatorial reasoning can be trained so that students are accustomed to having combinatorial thinking skills which shows an increase from 19.7% to 50% [15]. Based on this, it is necessary to have a combinatorial reasoning ability profile using essay tests in physics learning.

METODH

The aim of the study to determine the profile of the combinatorial reasoning abilities of physics learning in high school students. The subjects used in this study is a student at high school grade XI of the three schools who have studied the physics for one semester. The assessment instrument used was 20 descriptive questions and a questionnaire on students' confidence in working on combinatorial reasoning questions. The research method used is the Anlyze Design Development Impelemntation Evaluation (ADDIE) model , which is the iterative instructional design process, where evaluation is carried out at each stage before going to the next [16]. The ADDIE model is one of the systematic instructional designs are shown in FIGURE 1.

In this study, essay tests were developed to fit the indicators of assessing students combinatorial reasoning abilities and to identify students combinatorial reasoning abilities, namely exist which then the results of the tests carried out can then be categorized based on, namely: Existence Problem, Counting Problem, Optimization Problem [12].

RESULT AND DISCUSSION

Students' combinatorial reasoning profiles were assessed based on the results of the description test and based on a disposition scale to measure self-confidence in answering reasoning questions. This reasoning problem can train students to think combinatorial so that they are able to come up with new ideas to combine. In this study, the material being tested for class XI semester 1. The following are some examples of questions used in assessing combinatorial reasoning skills are shown in FIGURE 2.

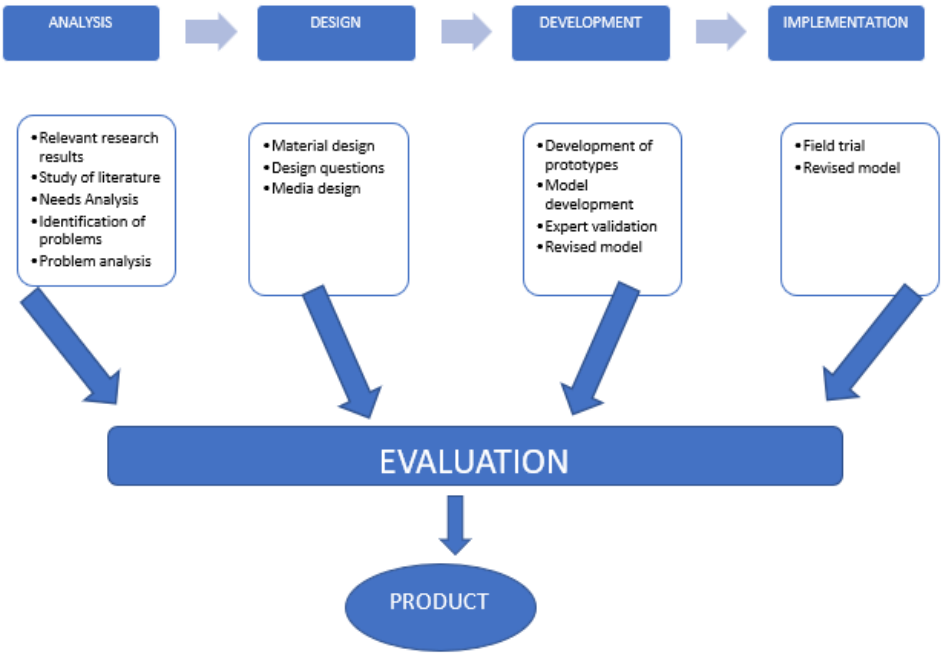
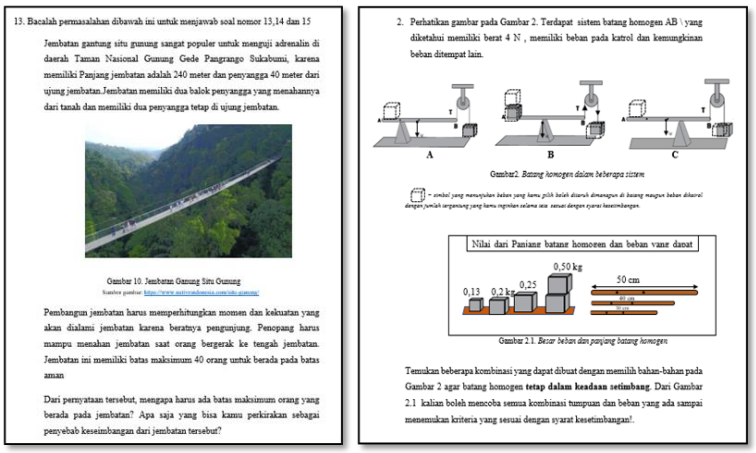
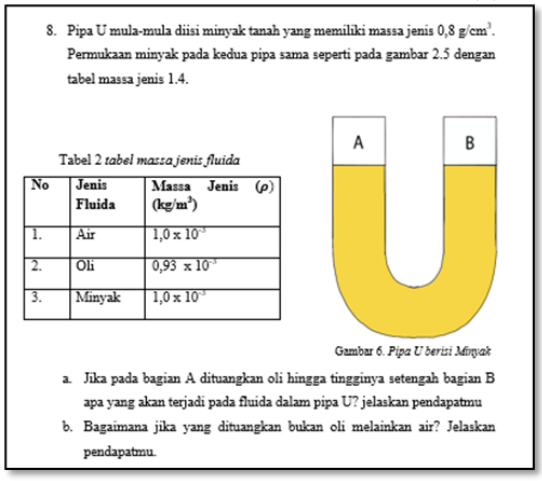


FIGURE 1. The ADDIE Model



(a) (b)



(c)

FIGURE 2. Combinatorial Reasoning Problems, a) Existance Problem, b) Counting Problem, c) Optimization Problem.

The description questions tested to determine the student's combinatorial learning profile consisted of three indicators. It can be seen that an example of a problem in Figure 1 (a) shows a problem with the existence problem indicator at this stage, students are asked to identify a case or problem to find out the cause, (b) Counting problem indicator where at that stage students take combinatorial steps,(c) Optimization Problem, in this question students are able to conclude an event that will occur in a problem[12].

Based on the results of the validation test combinatorial reasoning of assessment based on the indicators. The average percentage of material validation by student was 64.9% with very good interpretation and 0.97 for reliability. The results of expert validation test concicted of three aspect, namely substantance, construction and language which were analyzed using the Content Validty Ratio (CVR). The average percentage of CVR was 0.905 with a very good interpretation

TABEL 1. Indicator Analysis of Expert Validation

Number of tests	Indicator	Content of Validity Ratio	Interpretation
1, 3, 5 7, 8,18	Existence Problem	0,99	Valid
2, 6,14,17,	Counting Problem	0,99	Valid
4,9,11,19,20	Optimization Problem	0,99	Valid
10	Counting Problem	0,71	Invalid
12	Counting Problem	0,14	Invalid
13	Optimization Problem	0,71	Invalid
15	Existence Problem	0,42	Valid

Based on the tabel. There are four questions that are categorized as invalid instrument so they must be evaluated before being tested on field trials. The results of field trials using the Rasch Model. The Rasch model can be used to analyze the quality of tests that have been developed. The Rasch model is easy to use and has many interpretations to present and provide data meanings [17]. The analysis showed that 24% of students had a high level of combinatorial reasoning, in this case the students are able to fulfill the combinatorial stages. 64% of students were in the medium category and 10.83% of students were in the low category.

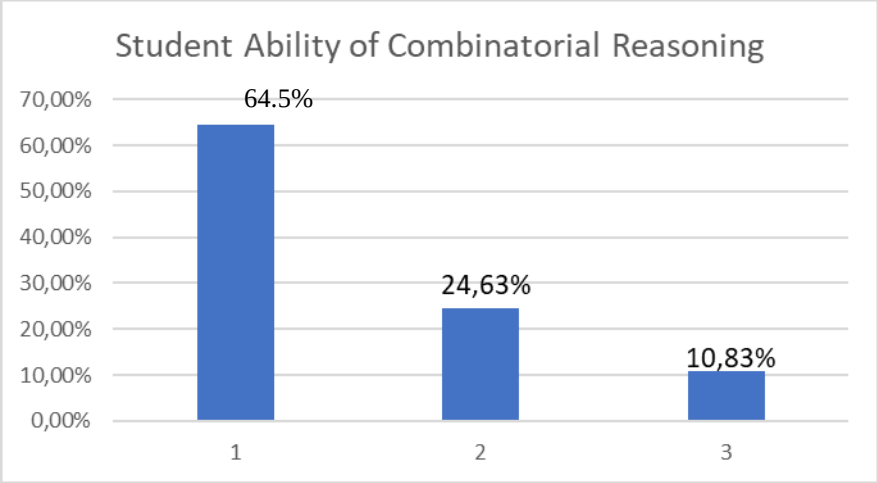


FIGURE 2. Students Profile

The result of field trials by student also provided a questionnaire consisting of aspects of confidence ,difficulty in doing the questions, and the structure of language. The average percentage of field trials to students was 79% students feel confident in doing the combinatorial description test, 62% find the combinatorial description test was difficult and 67% intrested in working on the description test.

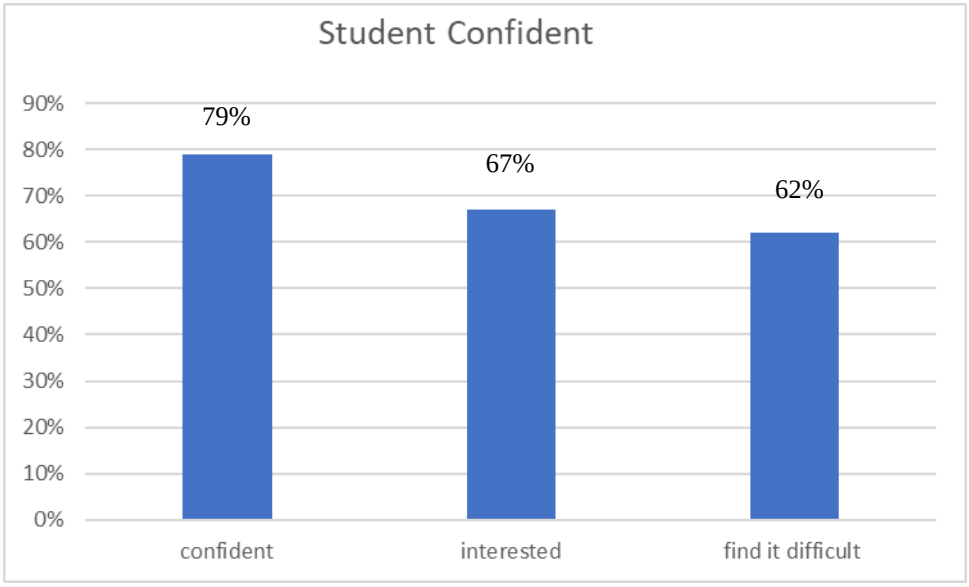


FIGURE 3. Data on students' questionnaire

The average of all aspects of the feasibility test and the field test of combinatorial reasoning student profile with description test are in very decent interpretation. This shows that the description test decent as assessment tool to know the profile of studentt's combinatorial reasoning ability.

CONCLUSION

Based on the results of the research of the combinatorial reasoning ability profile of students in physics learning showing low category with a percentage of 24.63% of students who are able to complete the combinatorial stages of solving the description questions, this is because students are not get used to understanding the form of questions where the questions presented require students to construct an independently combining the possibility of each answer. Students also has a relatively low profile of combinatorial reasoning abilities.

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