

# Profile of Cognitive Ability Students in Application of Newton's Law About Motion Topic

Zahida Aliatul Zain  
Physics Department  
Universitas Negeri Makassar  
Makassar, Indonesia  
28zahida@gmail.com

Abdul Haris  
Physics Department  
Universitas Negeri Makassar  
Makassar, Indonesia

Khaeruddin  
Physics Department  
Universitas Negeri Makassar  
Makassar, Indonesia

**Abstract**— This study is survey research that aims to describe the cognitive abilities of students in grade X MIPA MAN 2 Makassar. The domain of cognitive abilities studied included the ability of knowledge (C1), comprehension (C2), application (C3), analysis (C4), synthesis (C5), and evaluation (C6). The variables in this study are the cognitive abilities of students. The research subjects were students of grade X MIPA MAN 2 Makassar, which numbered 269 people. Data obtained from research results by giving cognitive ability tests. The data analysis technique used is descriptive statistical analysis. Based on the results and discussion, there are 149 students insufficient category with a percentage of 55,4%. Thus, from this article can be concluded that our students quite trained in working on questions in the form of the application of physical formulas and cognitive abilities of students in grade X MIPA MAN 2 Makassar are more dominant in female students compared with male students.

**Keywords:** *cognitive ability students, Newton's Law, motion*

## I. INTRODUCTION

Not something new, if students think that physics is a lesson that is difficult to learn compared to other subjects [1,2]. One of the most important physics material is about Newton's law, especially for the topic of motion. In Force and Motion topic, one of the difficult topics is Newton's Law. Student's achievement in Force and Motion topic is poor [3–5]. The most important thing for teachers is the students' initial knowledge, which they can use for their own capital and understanding based on their daily experiences [6,7].

Bloom's taxonomy can be used to classify cognitive thinking and related behavior in six levels of hierarchy. The level identified in Bloom's taxonomy is to classify goals and questions. Classification of goals and questions is fundamental in guiding student learning. Although Bloom's taxonomy is not only possible to classify the level of thinking, it is known and used in education, and therefore provides a good starting point for high-level teaching in the development and learning of his thinking. Nevertheless, Bloom's taxonomy is used to move students beyond the stages of simply remembering and literal understanding [8–10]. Low-order questions (knowledge,

understanding, and level of application) are questions used in providing basic or factual knowledge, which must be adapted to students' current understanding [9].

Meanwhile, a number of theories about cognitive development have been put forward by researchers. Piaget, as a researcher in cognitive development, explains four stages. Where the fourth stage, according to Piaget, intellectual development is the formal operational level. In the process of development towards a higher level. So that at the age of 12 - up, the level of mastery is expected to be mastery of the cognitive domain, which includes knowledge, understanding, application, analysis, synthesis, and evaluation [11].

Cognitive learning is characterized by learning to acquire and use representative forms that represent objects that are presented in a person through responses, ideas, or symbols, which are all mental things [12,13]. The chosen activity must support the cognitive abilities that have existed in every child from an early age. This will make children's cognitive abilities can be honed early and do not get difficulties at a higher level of education [14,15]. Based on the explanation above, the researcher argues that cognitive ability is the ability to think that can be observed from its activities, through experiences gained from the surrounding environment where each student has a different level of ability because it is influenced by the talent that is in him since birth and the environment around him, including the ability of students to solve physics questions. The ability of students to solve physics problems is also influenced by basic abilities or initial knowledge in the form of concepts that can support the ability of these students.

Newton's Law about Motion Topic are the three laws of physics that form the basis of Classical mechanics. Classical mechanics itself is an important component of physics. So, start from this basis is very important to know the student's cognitive abilities for Newton's Law about Motion Topic to move on to the other material in physics [3,6].

Evaluation is needed to measure the extent to which the objectives that have been set have been reached and obtain

proof of the extent to which students are able to understand the material taught by the teacher. From these results, the school and the teacher can determine the attitude to find the right solution. Based on the description above, the purpose of this study is to obtain a profile of students' cognitive abilities for Newton's Law about Motion Topic.

**II. EXPERIMENTAL**

The researcher conducted a descriptive study to obtain a profile of student's cognitive abilities of 269 students in grade X in one of the senior high schools in Makassar city, South Sulawesi. The subjects chosen are tenth-grade students who have received Newton's law lessons in senior high school. This study was conducted once. The method used is survey research. The instrument used is the test of cognitive ability. The level of cognitive abilities includes remembering (C1), understand (C2), apply (C3), analyze (C4), Evaluate (C5), and create (C6). About Newton's Law of motion, which analyzes the interaction of force and the relationship between force, mass, and the movement of objects about straight motion. Questions consist of 20 multiple choices and 6 essay tests. It has been developed and validates by experts.

After scoring, the next step is determining the percentage of each level, the percentage of the process is done by using Eq. 1.

$$\% = \frac{\text{score each indicator}}{\text{total score each indicator}} \times 100\%$$

Student data scores and the percentage will be used by the researcher to conduct descriptive analysis. Descriptive analysis is conducted to provide an overview and obtain complete information related to the profile of cognitive ability. A whole data that have been analyzed with the formula (1) is used to classify the student's cognitive abilities based on the gender of the student.

**III. RESULTS AND DISCUSSION**

*A. Student cognitive ability*

The level of cognitive ability includes remembering (C1), understand (C2), apply (C3), analyze (C4), evaluate (C5), and create (C6). In this study, the first four levels tested by multiple choices, and others level tested by essay tests. The following shows the average score for each cognitive domain. The profile of cognitive ability can be seen in Figure 1.

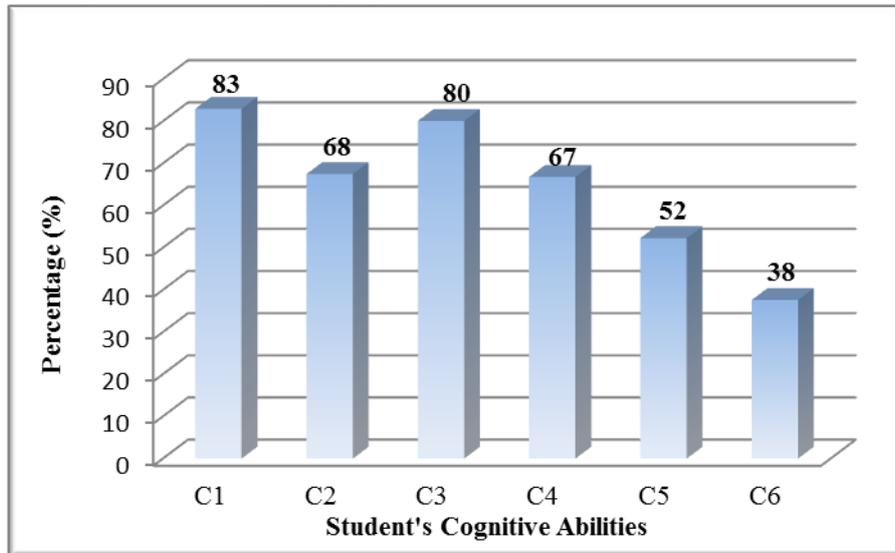


Fig. 1. Cognitive Ability profile of students

Based on the theory that the six levels of the thought needed in the cognitive domain according to Bloom's Taxonomy, if sorted by pyramidal hierarchy, it starts from knowledge, understanding, application, analysis, synthesis, and evaluation. These six levels of thinking in the cognitive realm oppose the continuum and overlap, where the higher realm contains all the domains below it [9,10]. This may not be so in accordance with the results of the measurements made, where

there is actually one level that looks not overlap and continuum, i.e., on the "apply" aspect (C1) is higher than "understand."

*B. Student cognitive ability based on gender*

The cognitive abilities of students based on gender background can be seen in statistical data on the cognitive abilities of male and female students in table 1. And gr

TABLE I. STATISTICS ON THE SCORE OF COGNITIVE ABILITIES OF MALE AND FEMALE

Statistic	Statistic Score			
	Male Students		Female Students	
	Multiple Choice	Essay	Multiple Choice	Essay
Mean	16,48	10,86	15,87	12,29
Standard Deviation	2,72	4,26	2,42	3,95
Variance	7,42	18,14	5,88	15,58
Range	12	19	15	17
Minimum	8	0	4	3
Maximum	20	19	19	20
Number of Subjects	104	104	165	165

Based on research data by classifying the scores of cognitive abilities of students according to the gender of students. The following is the percentage comparison of the cognitive abilities of male and female students.

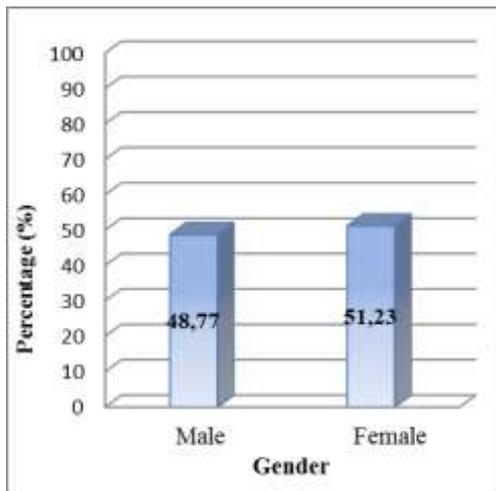


Fig. 2. Percentage Diagram of the Score of Cognitive Abilities of Male and Female Students

In addition to describing the cognitive abilities of students in general. This study also shows the comparison of cognitive abilities of students by sex. Where based on the research shown in the book Human Intelligence shows that women's cognitive abilities are higher than men. Although the comparison is not significant enough [16].

There is a lot of speculation, and studies of the comparison of cognitive abilities based on gender are not new. In Indonesia, we have often encountered this kind of research, one of which is always a benchmark for the national picture is the results of PISA measurements. The results of the last measurement in 2015 showed that male and female students had differences in the interest in science-related fields of work. In all countries, women are interested in the health sector than men, and most countries, men are interested in becoming ICT professionals, scientists, or engineers than women. But this is very different from Indonesia. 22% of women in Indonesia choose to work in the science field than men who only 9%. Also, 9 out of 10 Indonesian women choose to work in fields that are closely related to science, namely as health experts

[17]. The difference in the interest of these students indirectly affects their cognitive abilities [18,19].

The results of measurements of cognitive abilities that have been done show that the ability of female students is still higher than men, although not so significant. But if we examine further, we will see that cognitive abilities are not so different (even almost the same) for data in the middle class, but it will be very noticeable the difference for the highest and lowest extreme values. Although the overall value of overall female students is higher than that of women, in fact, the highest score obtained is actually achieved by male students, but of course, this is then balanced with low values, which are mostly inhabited by men as well. This is also in accordance with the results of other studies, where extreme values for science and mathematics subjects are mostly filled by male versus female students [16,20].

Successful careers in mathematics and science require many types of cognitive abilities. Female students tend to excel in verbal abilities, with large differences between women and men found when assessment includes writing samples [21–26]. Initial experience, biological factors, educational policies, and cultural contexts affect the number of women and men who take advanced studies in science and mathematics, and then everything will accumulate into something far more complex. There is no single answer that can answer each of these differences [27,28].

#### IV. CONCLUSION

Based on the results and discussion, it can be concluded that the cognitive abilities of grade X MIPA students in MAN 2 Makassar are in the sufficient category. Where for the ability of knowledge (C1) and application (C3) are in a good category, comprehension (C2), analysis (C4), synthesis (C5) are in the sufficient category, and evaluation (C6) is in a low category. This shows that the students in MAN 2 Makassar are quite trained in working on questions in the form of the application of physical formulas, and the cognitive abilities of students grade X MIPA in MAN 2 Makassar are more dominant in female students compared with male students.

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