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Analyze of Student's Higher Order Thinking Skills to Solve Physics Problem on Hooke's Law

Wulan Trisnawaty

Mathematics Education Department, STKIP Bina Insan Mandiri
Jalan Raya Menganti Kramat No 133, Wiyung, Surabaya, Indonesia

[a)]Corresponding author: w.trisnawaty@gmail.com

Abstract. The aim of this research was describing of student's higher order thinking skills to solve physics problem on Hooke's law. The research has been implemented in students of XIth grade at Senior High School with IPA Major that selected by random sampling. The research step was dividing into 5 steps: 1) preliminary, 2) planning, 3) implementation and observation, 4) analyze, and 5) conclusions. The methods of data collection by observation, tests, and questionaire. The results of this research describe that higher order thinking skills on analyzed component persentage of 77% on both problems with good category, evaluate component percentage of 75% in first problem and and 65% in second problem with quite well category, and create component percentage of 55% on both problems with quite well category.
Keywords: higher order thinking skills, physics problem

INTRODUCTION

Learning according to Gagne (1977) is a behavior change that happen as a result of an experience or training. It means that students behavior can be realized through some exercises from teacher during the learning [1]. However in fact, learning in the classroom only oriented to how students can solve arithmatic problems by using a formula without paying attention of their behavior change. The lesson presented is less interesting for students to think deeply to find solutions of their problem. Physics as one of the lesson with Kriteria Ketuntasan Minimal (KKM) has not be achieved yet by students (Balitbang Kemdikbud, 2014) should be the particular concern for teachers [2,10]. The lesson taught in physics is presented real problems in daily life, which requires students to think and apply the concepts. They often find it difficult and have not been able to solve correctly. It cause the students' ability to solve physics problems and build their own concept extremely low.

Results of study from The Organization for Economic Cooperation and Development (OECD) in the Programme for International Student Assessment (PISA) in 2003 states that students in Indonesia only able to recall facts, terminology and laws of science but they have a low ability when find a contextual problem that require problem solving abilities [2,9]. To decide something that is logical and reflective, students should have skills called higher order thinking skills. Higher order thinking skills is a cognitive operation that needed during the process of thinking in the short term memory. Higher order thinking occurs when someone takes new and stored informations in their memory, interconnected or reorganize them, and extend that information to achieve the goal or find a possible answer in a confusing situation (Rianawaty, 2011) [3]. Skills that include on higher order thinking skills are critical thinking skills, logic, reflection thinking, metacognitive thinking, and creative thinking skills.

According to Lewy, et al (2009) higher order thinking skills are the student's ability to complete a task without algorithm, which requires justification or explanation for more than one possible solution [4]. In Bloom's Taxonomy, student's ability involves analyzing, evaluating, and creating considered as higher thinking skills (Pohl, 2000) [5]. With this capability, it is expected that students can connect to a variety of instructions (clue) and facts with their knowledge to make a prediction of the final result. Krathwohl (2002) in A revision of Bloom's Taxonomy states that indicator can measure higher order thinking skills as follows [6]:

Table 1. Higher thinking skills component

Higher Order Thinking Skills Component	Indicators
Analyze	Formulate the problems
	Hypothesis
	Collecting data
Evaluate	Analyzing of data
	Conclusion
Create	Create a product

Based on three components of higher order thinking skills in the table above, each indicator assessed by a scale from 1 to 4. The total value of that indicator converted using the formula: (Arikunto, 2010) [7]

Table 2. Higher order thinking skill category

Category	Range
Great	76% - 100%
Good	51% - 75%
Nice	26% - 50%
Bad	< 25%

Based on that discussion, research wanted to analyze the student's higher order thinking skills on Hooke's law to solve physics problem correctly.

RESEARCH METHODS

This is a qualitative research to describe of student's higher order thinking skills. Subject on this research were students of XIth grade in IPA major with subject selected by random sampling. The steps of this research divided into 5 steps include: 1) preliminary, 2) planning, 3) implementation and observation, 4) analysis, and 5) conclusions. Data collecting techniques by observation, tests, and questionaires. The results were analyzed descriptively qualitative.

RESULT AND DISCUSSION

Based on this research, the result is follow:

Tabel 3 The result of student's higher order thinking skills

Higher Order Thinking Skills Component	Problems1					Problems 2				
	Student A	Student B	Student C	Student D	Student E	Student A	Student B	Student C	Student D	Student E
Analyze	83%	67%	83%	75%	75%	83%	75%	75%	67%	83%
Evaluate	75%	63%	75%	63%	75%	63%	63%	75%	63%	63%
Create	75%	50%	25%	75%	50%	75%	50%	50%	25%	75%

From the table above, it is known that there were two problems given to five students to describe their higher order thinking skills. In analyze and evaluate components, all students got score more than 50% in two problemss, while in creative components there were only six students got score less than equal to 50% in two problemss. Summary of that result for each component and its convert was presenting as follows:

Tabel 4 Summary of the result of student's higher order thinking skills

Higher Order Thinking Skills Component	The Result			
	Problems1		Problems 2	
	Percentage	Category	Percentage	Category
Analyze	77%	Great	77%	Great
Evaluate	70%	Good	65%	Good
Create	55%	Good	55%	Good

From Table 1.4 known that analyze components in problems 1 and problems 2 were in great categories, however the percentage only 77%. It showed that the analysis at the component still did not achieve maximally by students. Analyzing the problem was describing the material or concepts into their section, determining the relationships between their section or relationship of the overall structure and purpose (Surya, 2015) [8]. The result in Table 1.3 also described that there were still two students who got the percentage of 63% for analyzing categories. It meant that they had not been able to distinguish, organize, and connecting between components in the problems. It can be seen in the student answer sheets as follows:
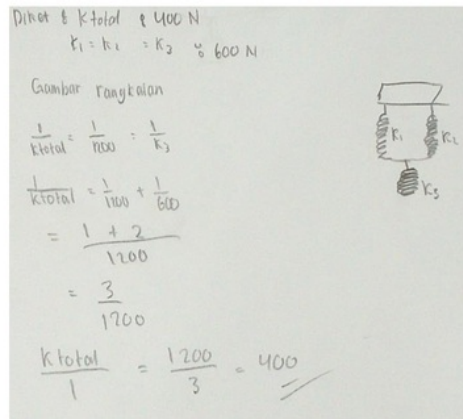
Picture 1. Student answer sheets of student A

From that picture, the students wrote some known information from the problems but using symbols that unsuitable with the unit. The unit of characteristic of the spring, that symbolized by "k", was written in "N" even though it should be written in "N/m". Even in this research also found that students seldom write the unit in the answer sheets.

In evaluate component, it is gotten the score 70% in problems 1 and 65% in problems 2, which both of them in good category. This percentage was still not optimally even though the category had been good. It was caused by students that unable to define or predict the answer of their problems. They also difficult to complete arithmetic operations that complex and complicated. Besides that, students got difficulty to connect between the unknown terms on the problems with the formula that was used to solve the problem. It is presented from the answer of students as follows:

Picture 2. Student answer sheets of student B

In the Picture 2, the students did not do the calculations at all. Based on interviews that conducted by researchers, students felt confused to use the formula that suitable to solve the problems. Moreover, the problems were complex and used some formula that connected each others. Brookhart in Surya (2015) states that higher order thinking skills (HOTS) means that students can apply their develope skills and knowledge with unthought concept but it has been taught [8]. Therefore, to improve the student's higher order thinking skills, teacher can give an open ended problems, task in the classroom, and feedback on learning.

The last component on student's higher order thinking skill is creative. Problem 1 and problem 2 got good category but the percentage was only 55%. Creating or create is entering the elements to form a coherent unit or reorganize the elements into a new pattern or structure through generate process, plan, or produce (Surya, 2015) [8]. The skills of students to synthesize the parts of their knowledge into something new, new form, or new product still not understand by students. It can be seen in student's answers sheet as follow:

Picture 3. Student answer sheets of student C

Based on Picture 3, students difficulties to synthesize the total results of characteristic of the spring to arrange to be new series so that the total result of characteristic of the spring suitable with their calculation. They also do not understand yet how to organize the elements or parts of their information to be a new concept that never exist before. This causes the create component got the percentage of 55%.

CONCLUSION

Based on this research, it can be described that the student's higher order thinking skills in analyzing the component got the percentage of 77% in all problems with great category, evaluating the component got the percentage of 75% in problem1 and 65% in problem 2 with good category, and creating the component got the percentage of 55% in all problem with good category.

ACKNOWLEGMENT

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FINAL GRADE

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GENERAL COMMENTS

Instructor

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