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Self Assessment for Student Performance Based on Higher Order Thinking Skills in Physics Learning

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Abstract

This research is aimed to develop Self Assessment Based on Higher Order Thinking Skills (SSA-HOTS) instrument in learning physics to train student's higher order thinking Skills. The development model using 4D from Thiagarajan with fifteen students as the subjects from Muhammadiyah 4 Senior High School with IPA Major. It was selected by random. Data collection techniques include test, observation, and questionnaire distribution then analyzed using correlation test. From the result of the research, it is found that the developed instrument is deserve to use, high reliability value, difficulty of problem proportional, and test item sensitive. Correlation assessment between student and teacher on cognitive, psychomotor, and affective aspects on the character of honesty and cooperation each 0.95; 0.83; 0.81; And 0.80 are in the high category. Students also responded positively to this instrument. So it can be concluded that the self assessment instrument based on Higher Order Thinking Skills is deserve to be used to train student higher order thinking skills.

Keywords: *self assessment, higher order thinking skills, physics learning*

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Introduction

Permendikbud Number 54 of 2013 on Graduate Competency Standards explains that Graduate Competency Standards (SKL) is criteria of graduate qualification that includes attitude, knowledge. It is this regulation that underlies the government applying the Curriculum 2013. In the curriculum of 2013, assessments include attitude, cognitive, and skills assessment. Self assessment is distinguishes between the assessment in the 2013 curriculum with the previous curriculum. Assessment as a valuation in principle is designed to provide feedback to students, parents, teachers, and school administrators about teaching effectiveness. To obtain a valid assessment result, the learning assessment should be conducted periodically, continuously, and comprehensively in order to monitor all aspects of student's ability (Haryoko, 2009). In addition students need to know what their abilities are, how much progress they have made and what they can do with those skills. With such knowledge, they do not have to rely entirely on the teacher and can accurately assess so they can learn efficiently.

From the results of a survey of Senior High Schools and equivalent in West Surabaya (2016), from 20 schools both private and public, the whole school has not involved students in the assessment process. Based on interviews with 12 classroom teachers in 3 different schools, there are several reasons why teachers do not involve students in the assessment process. Almost 50% of teachers assume that students have not been able to assess objectively, 30% of teachers assume that students have not been able to provide correct assessment according to the rules, and 20% of teachers assume that the assessment is only eligible to be given by the teacher. One of the factors that cause students to be considered unfit to self-assess their performance results is their poor Skills in deciding things. To be able to decide something that is logical and reflective, students must have skills called higher order thinking skills (Rianawaty, 2011). She also says that higher order thinking or what we then refer to as Higher Order Thinking Skills (HOTS) is a cognitive operation that much-needed on the thinking processes that occur in short-term memory. Higher order thinking occurs when a person takes new information and information stored in memory and interconnects or rearranges and extends this information to reach a goal or find possible answers in confusing situations (Rianawaty, 2011). Higher order thinking or higher order thinking Skills basically covers three aspects of Bloom's taxonomy. These three aspects are aspects of analysis, evaluation aspects and aspects of creating. With this capability students are expected to connect various clues and facts or information with the knowledge they already have to make a predicted of the formulated outcome.

Based on the above issues, we developed the Self Assessment Based on Higher Order Thinking Skills (SSA-HOTS) instrument to assess students' performance in physics learning which includes knowledge, attitude and skills fields. In addition, with the self assessment instrument is expected to trained high-order thinking of students who are very useful for them in facing the era of globalization.

Research Methods

This research is a development research with research subjects of high school students of class X IPA with fifteen students from Muhammadiyah 4 Senior High School. The design used is research and development following the 4D (Four D Model) development model developed by Thiagarajan. Data collection techniques were obtained using tests, observations, and questionnaires as follows:

PEDOMAN PENSKORAN
STUDENT SELF ASSESSMENT BASED ON HIGHER ORDER THINKING SKILL (HOTS)
ASPEK KOGNITIF

- PETUNJUK:**
1. Analisislah setiap butir soal berdasarkan uraian jawaban yang tertera di dalam pedoman penskoran.
 2. Berilah skor sesuai dengan yang tertera pada kolom skor bila sesuai dengan uraian jawaban dan skor 0 bila tidak terpenuhi.

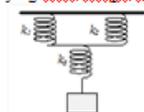
No.	Uraian Jawaban	Skor
1.	<i>Diketahui:</i> $k_1 = k_2 = k_3 = 600\text{ N/m}$ $k_{\text{gab}} = 400\text{ N/m}$	1 1
	<i>Ditanya:</i> Rangkaian pegas agar nilai $k_{\text{gab}} = 400\text{ N/m}$	1
	<i>Jawab:</i> Pegas dirangkai paralel: $k_p = k_1 + k_2$ $k_p = 600 + 600 = 1200\text{ N/m}$	1 1
	Kemudian dirangkai seri: $\frac{1}{k_{\text{seri}}} = \frac{1}{k_1} + \frac{1}{k_2}$	1
	$\frac{1}{k_{\text{seri}}} = \frac{1}{1200} + \frac{1}{600}$	1
	$\frac{1}{k_{\text{seri}}} = \frac{1}{1200} + \frac{2}{1200}$	1
	$k_{\text{seri}} = \frac{1200}{3} = 400\text{ N/m}$	1
	Berdasarkan analisis perhitungan diatas dapat diketahui bahwa agar diperoleh nilai konstanta pegas gabungan sebesar 400N/m maka pegas harus dirangkai secara paralel dahulu, lalu dirangkai seri. Gambar rangkaian pegas yang benar sebagai berikut:	
		1
	<i>Jumlah</i>	
<i>Bobot</i>		6
<i>Skor Nomor 1</i>		60

Figure 1. Data Collecting Techniques Using Test

LEMBAR PENILAIAN
STUDENT SELF ASSESSMENT BASED ON HIGHER ORDER THINKING SKILL (HOTS)
ASPEK PSIKOMOTOR

Nama Siswa	Kriteria Penilaian	Skor Maksimum	Penilaian Siswa
	a. Kemampuan siswa dalam menggunakan neraca pegas	4	
	b. Kemampuan siswa dalam mengukur pertambahan panjang pegas	5	
	c. Merangkai pegas secara seri dan paralel	3	
	TOTAL	12	

Nama Siswa	Kriteria Penilaian	Skor Maksimum	Penilaian Guru
	a. Kemampuan siswa dalam menggunakan neraca pegas	4	
	b. Kemampuan siswa dalam mengukur pertambahan panjang pegas	5	
	c. Merangkai pegas secara seri dan paralel	3	
	TOTAL	12	

Figure 2. Data Collecting Techniques Using Observation

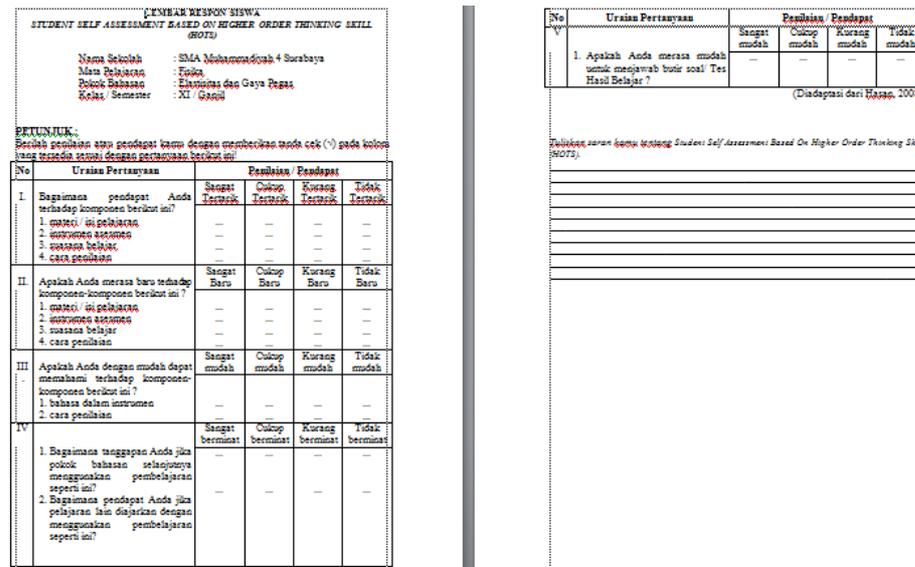


Figure 3. Data Collecting Techniques Using Questionnaires for Students

The results were analyzed descriptively qualitative and using correlation test

Result and Discussion

Based on the research that has been done obtained these following results.

Instrument Validation

Before doing the research, the researcher validates the instrument to be used. Student Self Assessment Based on Higher Order Thinking Skills (SSA-HOTS) includes aspects of cognitive, psychomotor aspects, affective aspects of honesty and cooperation. Validation is done by experts who are competent in the field of education. With adapted from Gundlund (2006), the SSA-HOTS instrument validation summary is presented as follows

Table 1. Validity Result of SSA-HOTS Instrument

Instrument	Assessment	Category
SSA-HOTS Cognitive Aspect	4.6	Deserve
SSA-HOTS Psychomotor Aspect	4.4	Deserve
SSA-HOTS Affective Aspect of Honesty	4.3	Deserve
SSA-HOTS Affective Aspect of Cooperation	4.3	Deserve

(Adapted from Gronlund, 2006)

Gronlund (2006) mentions that the learning device is said to be proper if getting an average score between 3.45 - 4.64 and is said to be very deserve with an average score of over 4.65. From the results of the above validation analysis, it can be said generally that the developed instrument is deserve for use in the learning process. Gay in Sukardi (1983) says that validity is a measure that indicates the level of decent or possibility of an instrument. The instrument is said to be valid if it can measure what it wants to measure. This is in accordance with Nur (2005) who said that the well-structured learning tool is one of the factors that determine the quality of learning. So it can be said that the developed SSA-HOTS instrument is suitable for use in learning and can describe the learning outcomes to be measured.

Test Item Reliability

Reliability of assessment tools is the provision of a tools competence in assessing what it judges in Ibrahim (2005). In this study, the problem used in the form of a description so that according to Ratumanan and Laurens (2006), to determine the reliability of aspects of the form of description using Alpha formula. Based on the calculation, the result obtained reliability score of 0.87. Such values according to Ornstein in Ratuman and Laurens (2006) fall into the category of high reliability. This means that whenever the assessment tool is used it will produce relatively similar results. This is because from the beginning, researchers have followed appropriate procedures to develop this

instrument. Then before the test, the researchers also have consulted the instrument to the experts first. So it can be said that the assessment instruments developed are reliable.

Difficult Level of Test Item

The analysis of the difficulty of the question items based on Ibrahim (2005) obtained these following results.

Table 2. Difficulty of the Question

Number of question	Right answer (B)	Difficulty of the question (P)	Category
1	5	0,33	Sukar
2	10	0,67	Sedang
3	12	0,80	Mudah
4	12	0,80	Mudah
5	10	0,67	Sedang

(Source: Ibrahim, 2005)

From the table above can be observed that from 5 items given to the students, there is 1 problem that is classified as difficult, 2 the problem is classified, 2 the problem quite easy, It shows that the problem used in the SSA-HOTS developed instrument are proportional. The degree of difficulty of a question item is defined as the proportion or percentage of subjects who correctly answer a certain aspect of the item. The assumption used to obtain a good question, especially for the level of difficulty is a matter of balance. The balance is the existence of problems that include easy, medium, and difficult in proportion. However, based on the table we can also observe that item number 1 is in a difficult category. This is because the problem is included in the creation stage, where students are asked to design a series of springs in order to produce a certain constants value on demand. With student limited ability and when the teacher's lesson only explains the formula used to calculate the spring constants without giving an example of the application causes the student to have difficulty in working on this problem.

Sensitivity of Question Item

The sensitivity of an aspect is the ability of these aspects to measure the effect of learning (Ibrahim, 2005). In the research obtained sensitivity value of 0.25. Thus it can be said that the problem item used is sensitive. It means that more questions are answered right after learning than before learning. This is consistent with the explanation of Kardi (2000: 137) that the effective question is a question that the students answer more correctly after the learning process. So the results obtained by students after the learning process is a result of the lesson activity.

Correlation Test

In the created SSA-HOTS instrument, students are asked to assess themselves based on guidelines that have been developed by researchers. These guidelines contain what criteria should be rated by students and their scoring guidelines. Then the results are adjusted to the results of the assessment conducted by teachers using the same guidelines. The results of correlation test that is calculated using SPSS on cognitive, psychomotor, and affective aspects of honesty and cooperation character based on Sutrisno (2004) are obtained these following results:

Table 3. Correlation Assessment between Students and Teacher

Aspect that observed	Correlation Value	Category
Cognitive Aspect	0.95	High
Psychomotor Aspect	0.83	High
Affective Aspect of Honesty	0.81	High
Affective Aspect of Cooperation	0.80	High

(Source: Sutrisno, 2004)

From the table above, the correlation value of all aspects is in the high category. This shows that students have been able to assess themselves in all three domains using the guidelines that have been developed. The student's self assessing ability signifies that their higher order thinking skills have been working. Higher Order Thinking Skills (HOTS) are skills that used to process more information. The skills that include HOTS are critical thinking skills, logic, reflection thinking, mathematical

thinking, and creative thinking skills. According to Lewy, et al (2009) HOTS is the ability to complete tasks where no algorithm has been taught, which requires justification or explanation and may have more than one possible solution. From the results of the study also can be concluded that the developed SSA-HOTS instrument can be well understood by students so that it can be used to train self assessing skills. This result is in line with the research conducted by James and Jessica (2008) which conclude that assessment can trained student's skills in self monitoring, self esteem, improving understanding, identifying learning progress, and producing learning strategies that enhance student motivation and achievement. This implies that assessment is not only through measurement and reinforcement of learning outcomes, but rather towards strengthening the development of strategies, attitudes, skills, and essential cognitive processes for lifelong learning. (Widodo, 2010)

According to Trianto (2009), self assessing skills is very necessary in the learning process so that students can know what weaknesses they have so it can be determined what steps should be taken to correct the weakness. In addition, by allowing students to be involved in the assessment process, teachers have helped students understand the goals of the learning experience and success criteria. Ibrahim (2005) said that the assessment method can work effectively when students know the purpose of teaching and what criteria to measure the success of the goal. Knowing the goals and success criteria will help students to monitor their own progress.

Student Response

To describe the students' responses to the assessment instruments developed, students were asked to fill out a response questionnaire. This questionnaire contains five questions about the developed SSA-HOTS instrument. The results of the responses given by the students are as follows.

Table 4. Students Response to the SSA-HOTS Instrument

No	Questions	Assessment			
	How is your opinion about this components?	Very interesting (%)	Interesting (%)	Less interesting (%)	Uninteresting (%)
I.	1. Content of the lesson	35.00	58.35	6.65	0.00
	2. Instrument of assessmen	15.29	74.41	10.30	0.00
	3. Learning atmosphere	46.29	47.31	4.71	1.69
	4. How to assess	32.49	59.83	5.65	2.03
	Do you feel that this components new?	Very new (%)	New (%)	Less new (%)	Old (%)
II.	1. Content of the lesson	27.21	63.78	3.11	5.90
	2. Instrument of assessmen	10.11	74.68	15.21	0.00
	3. Learning atmosphere	40.58	46.87	12.55	0.00
	4. How to assess	48.55	40.01	8.58	2.86
	Do you feel easy to understand this components?	Very easy (%)	Easy (%)	Less easy (%)	Difficult (%)
III	1. Languages in instrument	29.10	51.37	16.12	3.41
	2. How to assess	26.59	51.44	15.40	6.57
	How about your opinion if the next topic we use this learning models?	Very interesting (%)	Interesting (%)	Less interesting (%)	Uninteresting (%)
IV	How about your opinion if the next topic we use this learning models?	43.05	42.77	10.59	3.59
	How about your opinion if the others lesson use this learning models?	40.65	40.51	15.98	2.86
V	Do you feel easy to answer the item of question in use this learning models?	Very easy (%)	Easy (%)	Less easy (%)	Difficult (%)
		4.25	48.09	39.68	7.98

(Source: Surono, 2008)

From the data above shows that students give a positive response for the developed instrument. This indicates that the developed of SSA-HOTS instruments are well received by the students. Thus the assessment instrument can be used to train studenters high order thinking skills.

Conclusions

Based on the results of research and discussions that have been described, it can be conclude that the developed instrument is deserve to use, high reliability value, difficulty of problem proportional, and test item sensitive. Correlation assessment between student and teacher on cognitive,

psychomotor, and affective aspects on the character of honesty and cooperation each 0.95; 0.83; 0.81; And 0.80 are in the high category. Students also responded positively to this instrument. So it can be concluded that the instrument of Student Self Assessment Based on Higher Order Thinking Skills appropriate for application in learning physics to trained higher order thinking skills of students.

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