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DEVELOPING AN INSTRUMENT FOR ASSESSING THE PHYSICS COGNITIVE LEARNING ACHIEVEMENT OF HIGH SCHOOL STUDENTS THROUGH LOCAL WISDOM-BASED FIELDWORK

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Abstract

This study aims to reveal (1) the construct and (2) the characteristics of the developed instrument for assessing Physics cognitive learning achievement of high school students in outdoor learning models through local wisdom-based fieldwork. This research was a research and development using the approach developed by Mardapi (2012: 110). The steps taken included (1) preparing instrument specifications, (2) writing the instrument, (3) reviewing the instrument, (4) doing instrument trial, (5) analyzing the instrument, (6) improving the instrument, assemble the test (8) implementing the test, and (9) interpreting measurement result. The results of the study showed that the Instrument of cognitive skills consisted of 50 items with two-tier multiple choices focused on indicators of cognitive skills. The instrument was categorized fit the PCM 1PL and the difficulty level of the items ranges from -1,00 to 1,22 which means the items were in a good category. The reliability of the items was 0,89 for the ability ranging from -2 to 2 with standard error measurement 0,23, which means it was in a very high category.

Keywords: *Assessment; Cognitive; Outdoor Learning; Fieldwork; Local Wisdom.*

A. Introduction

Learning is the process of interaction that occurs among students, between students and teachers, as well as with learning resources in a learning environment (Regulation of the Minister of Education and Culture of the Republic of Indonesia year 2016 No. 22). Learning is done in order to build learners' knowledge. The learning process in educational units held in a fun, challenging, interactive, inspiring, that can motivate learners to be active, as well as being able to provide enough space for initiative, creativity and independence, in accordance with the talents, interests, and physical and psychological development of the learners (Government Regulation of the Republic of Indonesia No. 32 Year 2013). Each unit of education does the planning, the assessment, and the monitoring towards the learning process as a form of implementation of the learning process that is effective and efficient.

Assessment of learning outcomes, as one of the educational process is able to provide a positive influence in order to achieve the goal of 21st-century learning (Pellegrino, 2014). The assessment is done to encourage the motivation of the learners so that they can be better in learning (Rosa, Coutinho, & Flores, 2016). This is then used by the teacher to find out the level of development of the students towards the learning goals from time to time.

But recently, there are still many who put aside the assessment activities. The assessment has not been done completely on various aspects and is still often done at the end of learning. Assessment instruments have not been able to measure aspects of cognitive, affective, and psychomotor (Astuti, Joon, & Rahayu, 2012).

Learning process also has an important role in a system of formal education. Based on the legislation of the Republic of Indonesia No. 20 year 2003 of the national education system article 1 No. 20, learning is a process of interactions that are performed by the students with teachers and learning resources in a learning environment.

In fact, learning process is more often done in the classroom. Essentially, in fact, learning can also be carried out around the school

neighborhood. Learning is conducted in the neighborhood around the school so that the learners are able to connect the subject matter with a natural phenomenon around in daily life. In addition, learning in the environment around the school also encourages social interaction of the learners.

The above statement is supported by preliminary research conducted by Febrina Rahayu Widya AS in the year 2017 which aims to 1) produce outdoor model learning through fieldwork based on local wisdom to improve the skills of collaboration and cognitive learning outcomes of the learners and 2) describe the effectiveness of the model outdoor learning through fieldwork based on local wisdom to improve the skills of collaboration and cognitive learning outcomes of the learner. In her research, Febriana developed a model of outdoor learning through fieldwork with several supporting Medias, such as the syllabus, RPP, LKPD, Textbook, and assessment instruments.

Outdoor learning needs to be done as the one the alternatives to avoid learner's boredom which focused on the learning in class. Essentially Physics is part of the science that applies the principles of problem solving on learners. Problem-solving here is expected to be exactly applied to the learners (Ibrahim & Rebello, 2012). It means that this problem-solving does not only require the teacher or peers, but also involves nature in its activities.

Physics learning tends to only involve the role of the teacher and focus on mathematical calculations (Onur, 2015). In addition, based on research conducted by Wulandari & Mundilarto (2016:375), it proved that Physics learning by integrating local wisdom and learning model was able to increase the understanding of the concepts that result in increasing cognitive learning results of the learners. Therefore, face-to-face learning combined with a model of learning which involves the environment as well as the existence of the integration of local wisdom is expected to enhance the spirit of learning to learners.

In today's modern era, it is often found learners who are already adept at using information technology as a learning media. It is not something that is negative. However, based on research, face-to-face

learning, either by teachers or peers still has its own pluses for the development of students' psychology.

Referring back to the assessment instruments used in research in the previous year, the needs of assessment tools in the learning process of Physics considered very importantly for the teacher. That's because the teacher is able to assist in evaluating the effectiveness of a study related to Physics that has been implemented. It is important for teachers to have a perception, understanding, and good skills in the assessment of learning Physics.

According Mardapi (2012: 12) assessment includes all the methods used to collect the data individually. The assessment conducted should focus on individuals in order to get a decision that is also generated for the individual. One of the assessments that have to be done is the assessment that is used to assess the cognitive aspect.

Some test instruments that can be used to assess cognitive learning include multiple-choice tests and/or descriptions. Istiyono (2013: 11) argued that the multiple-choice questions reasoned not only able to measure the ability to remember, understand, and implement, but also able to measure the ability of analysis, evaluation, and creation. The exact form of questions used to measure the ability to think from a low level to a high level. Additionally, Prihatni, Kumaidi, and Mundilarto (2016: 123) argued multiple choice questions have the ability to test the ability of learners to answer the questions correctly and evaluate the response obtained so as to generate a list of weaknesses or errors.

Based on the above description and preliminary research conducted, the researchers in this study considered it important to develop the cognitive learning outcome assessment. The results of this study hopefully will be able to improve the quality of teaching and assessment which is carried out by the teacher.

B. Method

This research is research and development. This research aims to produce a product such as the instrument of assessment of the Physics'

cognitive learning outcomes of high school students. This research resulted in the product in the form of an assessment instrument test which has a special stage. Therefore, this research is a research and development using an approach which developed by Mardapi (2012: 110).

Based on the development stages of these instruments, researchers used several stages to develop the test and non-test instrument. The development stages are carried out, inter alia: (1) preparing test specifications; (2) writing the tests; (3) examine the test; (4) test the test; (5) analyzing the test items; (6) improve the test; (7) assembling the test; (8) perform the test; and (9) interpret measurement results.

1. Techniques and Data Collection Instrument

The study was conducted in seven high schools in Klaten district starting from March to May 2018. Subject trials for limited trial test instrument in this study were 490 high school students. Limited trial subjects are the students in class XI SMA IPA program which were taken from six high schools in Klaten districts that have conducted on the Physics learning material, Rotation and Equilibrium Dynamics of Rigid Objects. Furthermore, the subjects of the field trials test instruments are 31 learners from class XI SMAN 1 Prambanan academic year 2017/2016.

Techniques and instruments used in this study have the objective to determine the constructions and characteristics of the assessment instrument which is developed. The technique used to collect data in this study includes the content validity of data collection techniques supported with the validation sheet, observation, testing the cognitive learning, and documentation. Data collection instruments used include validation instrument that aims to validate the instruments used in this study. Instrument validation in this study, is a cognitive achievement test.

2. Data analysis technique

Data analysis techniques in the study arranged according to the data collection instruments. This technique is divided into several stages, including the analysis of the results of the content validation, construct validity analysis,

item analysis, reliability testing test instruments, test instruments item difficulty, and analysis of the achievement of the ability of the learners.

Analysis of the results of the content validation, inter alia, use the expert agreement index suggested by Gregory (2007) expanded by Heri Retnawati (2016) to determine the feasibility of the content of the lesson plan. Test the validity of the content of the test instrument in this study using the formula V Aiken which is based on the results of the expert assessment of n people. At a minimum, in order to make the V index of Aiken instruments able to be said to be valid must be adjusted to the table of validity coefficients (Aiken: 1985). Construct validity was demonstrated by using exploratory factor analysis with SPSS 16.

Analysis of the cognitive learning items is calculated using the Partial Credit Model (PCM) 1 PL so that the validity of each item of test instruments is able to be known. The compatibility of the item with the model is known by fit items and testy which follow the rules of the Item Characteristic Curve (ICC) would be flat when the magnitude INFIT MNSQ for items> 1.30 or <0.77. Therefore, an item or testy (/ case / person) is stated fit to the Rasch models or model 1-PL with acceptance limits ≥0,7 until ≤1,30 (Adam & Khoo, 1996).

Instrument reliability tests analyzed using Quest software. Reliability of the test is able to be seen from the reliability based on the estimated item and reliability based on the estimated case or in a testy (Wrigh & Maste: 1982). The higher the value of reliability the more convinced that the measurement gives consistent results (Bambang & Pujiyati: 2011). In addition, the test reliability is reinforced by looking at the function of information and Standard Error Measurement (SEM) analyzed with software Parscale, which is the sum of all item information function tests.

The difficulty level of the test item can be concluded from the analysis using Quest software. Quest program presents a difficulty level of the item in the form of a threshold value (threshold) for RSM. Threshold value that is calculated is based on the value or as introduced by Masters (1988) follow the according to Turnstone (Adam & Khoo, 1996: 90). At the output of analysis

results using Quest program, the item difficulty can be seen in the Thresholds graph from the range of 2.0 to -2.0.

Scores obtained by the students summed and then converted into the category of qualitative criteria such as performance. Conversion guidelines are shown in table 1 (Widiyoko, 2009: 238).

No.	Score range	Category Quality
1	Mi + 1.8 Sdi <X	Very good
2	Mi + 0.6 Sdi <X≤ Mi + 1.8Sdi	Good
3	Mi - 0.6 Sdi <X≤ Mi + 0.6 Sdi	Enough
4	Mi - 1.8 Sdi <X≤ Mi - 0.6 Sdi	Less
5	X≤ Mi-1.8 Sdi	Very less

C. Research Finding and Discussion

The initial product produced in this research is the development of cognitive learning outcomes assessment instrument based on local wisdom for material of dynamics rotation and rigid object equilibrium.

The initial step in developing the instrument is determining the specifications and writing the instruments. In this step, the activities carried out are determining the purpose of the instrument, composing the blueprint of the instruments, as well as choosing the shape and length of the instrument.

The items which have been developed further are discussed with several experts in the field of evaluation, physical education, Physics, and teachers in order to get expert judgment. This stage is called the validation process by experts with the aim of getting content validity. Content validity was determined by calculating the coefficient of the validity using formula Aiken V of experts and practitioners. Based on the analysis of all the instruments developed, the contents are valid with Aiken V validity coefficient of more than 0.78.

These items have valid contents and then tested on a limited basis. The trial results are used as empirical data in order to prove the test construct validity, reliability, and characteristics of the instrument. In this stage, a trial was carried out on the test instrument of instrument of

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cognitive learning outcomes for physics learning. Instrument analysis using factor analysis with SPSS 16 to determine the construct validity.

Table 2, KMO Results and and Barlett Test Results of Cognitive Learning

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.697
Bartlett's Test of Sphericity	Approx. Chi-Square	5.804E3
	df	1225
	Sig.	.000

Based on the results of factor analysis, it is showed that the value of KMO of 0.697 or greater than 0.50, which means the sample size which is used in this trial is enough. In addition, the chi-squared value on Barlett test is 5,804E3 with the degrees of freedom in 1225 and the p-value in less than 0.01. This is in accordance with the opinion of Widarjono (2015: 197) that the KMO MSA test is used to measure the inter-correlation between variables. The matrix is able to be analyzed if it has a value of KMO> 0.5.

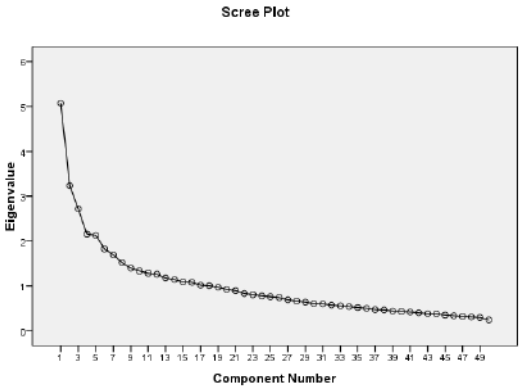

Figure 1. Plot Secree exploratory factor analysis results

Based on Secree plot in Figure 1, it shows that the component 1 is located far from the component 2, while the distance of component 2 to component 3 and so on is close. In addition to the pictures, it shows the Eigen values start sloping on all four components. This shows that there is one dominant factor and other factors contribute significantly to the variance that can be explained.

Based on the results, it can be said that the assessment tool tests of the cognitive learning content and construct is valid. There is one dominant factor with 18 indicators which are then translated into 50 indicators matter and item itself.

Furthermore, to determine the characteristics of the cognitive achievement test, item analysis is carried out using Quest program and Parsacale assistance. Valid criteria of Physics cognitive achievement test obtained based on the test suitability between Rasch model with 1 PL. Determination of the level of overall compatibility with test items Rasch model with 1 PL using Quest program. The test results can be seen in Table 3.

Table 3. Results of Instrumental Analysis Using the Cognitive Learning Outcomes Assessment Program Quest

No.	commentary	Estimates for Item	Estimates for Testi
1	The average value and standard deviation	-0.01 ± 0.49	-0.31 ± 0.28
2	The average value and adjusted standard deviation	0.00 ± 0.46	0.00 ± 0.25
3	Reliability	0.89	0.78
4	The average value and the standard deviation of INFIT MNSQ	1.00 ± 0.08	0.99 ± 0.15
5	The average value and the standard deviation of OUTFIT MNSQ	1.02 ± 0.12	1.02 ± 0.21
6	The average value and the standard deviation of INFIT t	-0.17 ± 1.76	-0.06 ± 1.02
7	The average value and the standard deviation of OUTFIT t	0.12 ± 1.44	0.06 ± 0.83
8	Item or testi with 0 score	0	0
9	Item or testi with perfect score	0	10
10.	The average of the Difficulty	0.00 ± 0.51	

Based on Table 3, fixing a match point with a model is able to be seen that the average value of the estimated items INFIT MNSQ limited test results are within the range of 1.00 and 0.08 of standard deviation so that the whole items of the instrument of cognitive learning outcomes for physics learning is suitable with 1 PL Rasch model. In addition, the testy

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match with 1 PL Rasch models is also able to be seen on the size of the average value of INFIT MNSQ testy estimate which value 1.00 with a standard deviation of 0.15. This means that the overall testy is suitable with the 1 PL Rasch model.

Testing the validity of cognitive learning outcomes assessment instruments is also reinforced by looking at the item characteristic curve (ICC). This curve can be seen by running the Parscale application. One item characteristic curve (ICC) on one of the items can be seen in Figure 2.

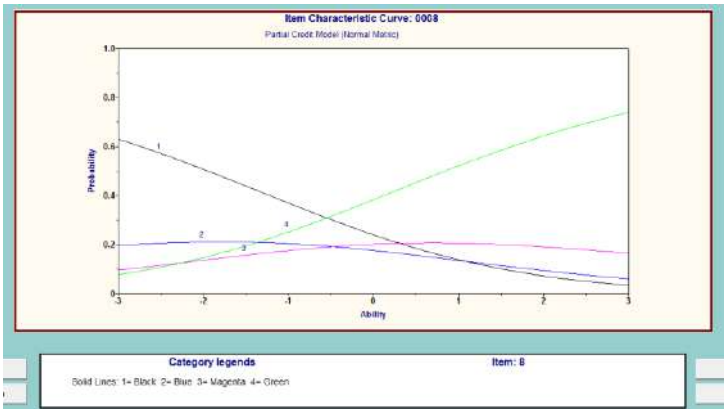

Figure 2. Item Characteristic Curve (ICC) Number 8

In IRT, besides observing reliability of the estimated value of the item, the reliability of an instrument is also able to be seen from the function of information and SEM which were obtained by running the Parscale program. SEM information function and cognitive learning outcomes assessment instruments can be seen in Figure 3.

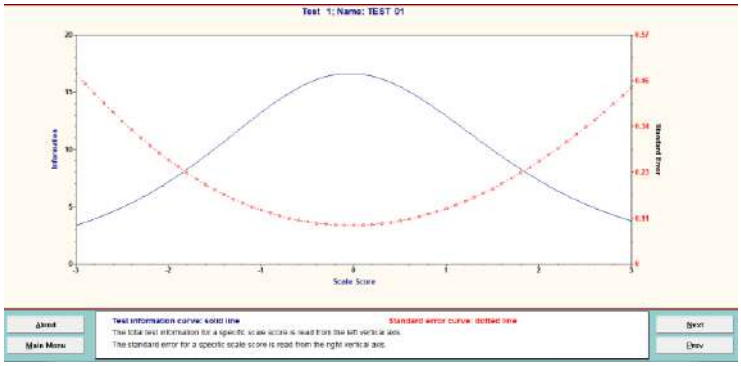

Figure 3. Function Test Information

Based on Figure 3, it can be said that assessment of cognitive Physics learning outcomes has a reliability value of 0.89 for the ability range of -2 to 2 with SEM 0.23.

The results of the difficulty analyzes contained in Table 6, located between -1.00 to 1.22 with an average of 0.00 and a standard deviation of 0.51. It concludes that whole items are the instruments that have been developed in both categories. Because the terms of an item instrument said to be good is as if the item has a difficulty level of more than -2.00 or until 2.00. The following is the range of the level of difficulty of items in the form of graphs.

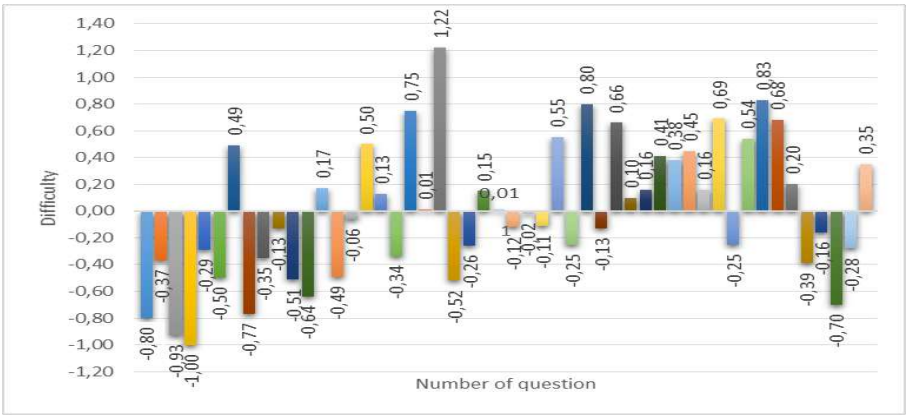

Figure 4. Graphic of Item Level Difficulties Learning Cognitive Test Results

After conducting the analysis and finding that all the items of cognitive ability is valid and reliable, the next stage is to use all or some of the items to be tested in the field.

This field test was conducted to determine the achievement of the learners. The achievement of the level of cognitive achievement of students based on cognitive learning outcome assessment instruments developed. The field testing trials instrument conducted in SMAN 1 Prambanan Klaten with the number of respondents as many as 31 students. Before learners get the points about the results of the development, learners perform the learning activities in advance.

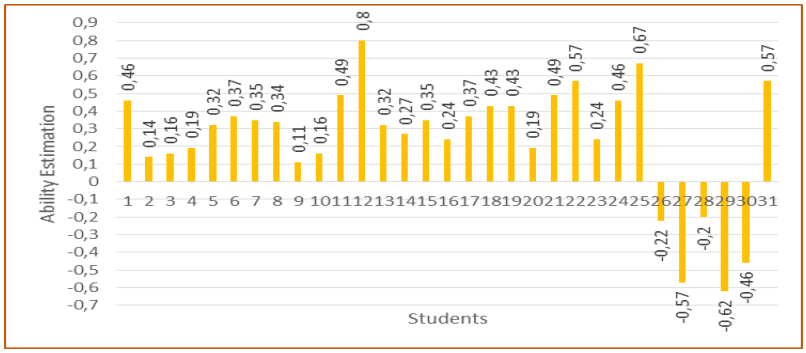

Figure 5. Graph Field Test Results of Cognitive Learning

Based on the chart obtained by the participants, the scores were obtained in the range of -0.62 to 0.8. In which this information is obtained from the results of 31 learners, there are 26 participants who get a value above the ideal value of the average and 5 people got values below the ideal value on average. The ideal average value is equal to 0. From this field test results, it can be said that the test instrument developed to measure the results of cognitive learning is effective. This is because the numbers of students that have a value above the ideal value on average is more than those who got below the ideal value on average.

D. Conclusion

Instrument construction of cognitive learning outcomes in learning through fieldwork outdoor models based on local wisdom is as follows:

Cognitive learning test assessment instrument have met the construct validity by factor analysis. 18 indicators with 50 rounds of multiple choice questions was developed regarding the cognitive learning outcome indicators that are retrieving, understanding, applying, analyzing, and evaluating.

The cognitive learning achievement test instrument developed matches the Partial Credit Model (PCM) with the MNSQ INFIT value so that the instrument is able to be stated as valid. The cognitive learning achievement test instrument developed has a good difficulty level category. Based on the function of the information, the cognitive learning

achievement test instrument is suitable to measure abilities from -2 to 2 with a SEM of 0.23.

The assessment instrument developed is able to measure the cognitive learning outcomes in the outdoor learning model through fieldwork based on local wisdom with the following results: the application of the cognitive learning outcome assessment instrument was able to measure the cognitive learning outcomes of high school students based on more students who scored above the ideal average than those below the ideal average.

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