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DEVELOPMENT DIAGNOSTIK *OF THREE TIER MULTIPLE CHOICE DIAGNOSTIC TEST INSTRUMENT* TO ASSESS LEARNERS ' ABILITY ON STATIC ELECTRICITY MATERIAL

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Abstract
This study aims to determine the feasibility and ability of learners to the instruments developed. This research was conducted at SMA Negeri 6 Pematangsiantarcarriedin the odd semester of the 2023/2024 academic year. The type of research used is R & D (Reaserch and Development) using 3D models. The study was conducted on students who have studied static electricity materials. The samples used in this study were 36 students from Class XII-IPA 3 taken byrandom sampling. Data collection techniques in this study is by way of interviews, tests, and provide a response questionnaire. Data analysis was performed using the person correlation equation with diagnostic tests. The results of this study is a test instrument to measure the ability of students in SMA Negeri 6 Pematangsiantar on static electricity as many as 20 items of diagnostic questionsthree tier multiple choice. The item is already valid measured by the estimated product moment, has a high level of reliability with a value of 0.712, the difficulty level of the item is good. The results of the analysis of the problem items and the analysis of the ability of students showed that the test instruments used are effective in measuring the ability of students in SMA Negeri 6 Pematangsiantar on static electricity.

Kata Keywords: Test Instruments, Ability, Physics

Introduction

The right way to learn is to create a high quality of learning, and this quality can be seen with the measurement values carried out (Subana, 2017).The expertise of an educator in working and using assessment, process improvement, and learning outcomes is useful as a benchmark to determine the level of achievement of goals in the curriculum (Budiman & Jaelani, 2014). In the event of teaching and learning and giving as well as providing evaluation activities for students, it is useful in knowing the scale of understanding of students in the material taught. And the thing that educators do in getting it is by giving an appropriate test instrument. The test instrument provided aims to assess the level of understanding of students in the material or subjects taught.

Test instruments are usually given with a number of questions that must be addressed in measuring the quality of understanding with mastery of the material and specific learning objectives. The tests performed can be carried out with several different forms of representation. However, in fact some test instruments in several fields of study use a single representation in formulating a concept. This makes the measurement regarding students ' concept comprehension at the slightest clarification. Among them are the fields of study of physics that still use a lot of

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mathematical representation (Sinaga et. al., 2014; Mahardika et. al., 2012; Leone & Gire, 2006).

Physics is part of the Natural Sciences (IPA) that analyzes natural phenomena and events with the scientific stage in observation, conjecture, experiment and assessment data made with a scientific foundation by producing scientific material in the form of concepts, rules and knowledge that run in general (Trianto, 2010). Furthermore, the reality of natural phenomena in physics is commonly interpreted in various representation formats such as scales, illustrations, and mathematical formulas, emphasizing the importance of multiple representation skills when studying physics. All concepts of physics can be described using representations, both symbols, text, images, graphs, diagrams, tables to mathematical equations. But in explaining concepts and solving physics problems, most students are accustomed to using only one representation. One solution to solve this problem well with a broader definition is to use multirepresentation (double representation).

Although dual representation is important in physics learning, learning activities in schools are now not aimed at improving students ' dual representation skills. The situation is indicated by several problems in the study Sinaga et. al., (2014) explained that the use of multirepresentation of physics 87% of prospective teachers have difficulty in understanding physics concepts caused by the difficulty of translating the representations used in describing concepts, Furqon and Muslim (2019) showed that the multirepresentation expertise of students was still small, and Kusumawati activities. al., (2019) showed that students ' multirepresentation skills were still dominant with mathematics performance skills at an average value of 80% of the total value.

Based on the results of the study, that the lack of improvement of educator test instruments for learners and the tendency in the use of items given only the form of ordinary questions that make learners less in showing the ability of representation in itself and the lack of innovative ways of thinking in students. However, it can also be indicators of the problems given already meet the indicators in measuring the ability of students multirepresntation in the form of graphs, images, or mathematical equations.

This is also in line with the assessment carried out by Furqon & Muslim (2019) and Kusumawati, et. al., (2019) on the multirepresentation skills of students doing problem solving in concept understanding. This is also the case in SMA Negeri 6 Pematangsiatar where most students can only make one type of representation mode physically correctly for the same concept. Differences in understanding of concepts can occur through two trends developed from recent studies, namely how students apply different representations when solving problems and how different representation structures affect student performance in problem solving, in addition to the use of good representation supports the success of mastering the concept of students themselves.

Instruments that still depend on using one representation can be said to be very lacking to be able to assess the ability of learners measured from the different levels of understanding possessed by each learner. Using multirepresentation models can be a solution to learning difficulties and help students ' understanding to solve physical phenomena. From the results of field research and interviews, teachers have not fully used multirepresentationin the teaching and learning process. The dominant representations made are mathematical and verbal representations in

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explaining a concept. Many students are still confused about doing physics problems by not understanding the concept of physics as a whole.Static electricity material is physics material for Class XII semester one in the 2013 curriculum. The discussion in this material is about the concept of coulomb force and electric field, Gauss's Law, potential energy difference, capacitor.
From this explanation, this study is important to develop a diagnostic test instrumentto assess the ability of learners on static electricity materials.

RESEARCH METHODS

This research was conducted at SMA Negeri 6 Pematangsiantar with the implementation time being in the odd semester of the 2023/2024 academic year. The type of research used is R & D (Reaserch and Development) with 3D models. The population in this study consisted of five classes with the number of students 175 students of Class XII-Science and the sample used in this research as many as 36 students of Class XII-Science 3. Sample selection is done by method. The study was conducted on students who have studied static electricity materials. Data collection techniques in this study is by way of interviews, tests, and provide a response questionnaire. The validity of the expert conducted was given to three appraisers and analyzed using the system. Data analysis was performed using the person correlation equation with diagnostic tests.

RESULTS AND DISCUSSION

- **Hasil Research Results**

1. Planning Stage

Test instruments in this study aims to measure the ability of students with multirepresentation of the two indicators that present a concept and implement the translation with many forms of representation (de & van, 2012; Klein et. al., 2017; Prain & Waldrip, 2006). The questions used are in accordance with the basic competencies regarding static electricity materials in accordance with the presentation aspects and presentation formats to be measured. In this study the problem consists of 20 three-level multiple choice questions, with a total of 8 questions measuring the ability of representation and 12 questions measuring the ability of multiple representation of students. For this study validation is given to three experts consisting of two lecturers and a teacher. It aims to analyze and evaluate the feasibility of instruments developed based on three aspects, namely material, construction and language. In this study some questions can be used without the need to revise and other questions can be used after doing a little revision. After revising the questions carried out from the results of expert validation, researchers can provide questions to students to complete the testing process. Tes yang digunakan pada penelitian ini adalah tes diagnostik Three tier multiple choice. The scoring technique used is CRI scale (Certainty of Response Index) and grouping students into categories that correspond to the answers given by students.

2. Instrument Test Results

The validity of the item question is measured by *the product moment* using the standard setting $\alpha = 0{,}05$. From this study it can be that 16 questions out of 20 questions obtained with valid results and 4 questions get invalid results. Not validan questions obtained because of several factors including, students answered

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with no serious or guessing, students do not understand the concept and students do not understand what is asked on the question. In this studythe reliability used is the kurder-Richardon equation KUrder-Richardon20 (KR 20) the reliability of the problem obtained is 0.712 with this result the instrument used can be said to be reliable. With the difficulty level of the problem obtained is 0.61. It is analyzed by comparing the number of correct answers and test results. In this study Problem Number 16 has a difficulty index of 0.44 (medium) and problems with Easy difficulty level with an index of 0.75. This can be seen from tabel1 the following table 1.

Table 1 level of difficulty item problem

Problem Number	P	Classification	Problem Number	P	Classification
1	0.53	Medium	11	0.61	Medium
2	0.61	Medium	12	0.50	Medium
3	0.56	Medium	13	0.69	Medium
4	0.50	Medium	14	0.69	Medium
5	0.64	Medium	15	0.61	Medium
6	0.50	Medium	16	0.44	Medium
7	0.75	Easy	17	0.67	Medium
8	0.69	Medium	18	0.53	Medium
9	0.69	Medium	19	0.56	Medium
10	0.75	Easy	20	0.75	Easy

The results of the test of discriminating power can be seen by the difficulty level of the upper group and the level of difficulty in the lower group. In this study the results of the distinguishing power can be seen in Table 2 below.

Table 2 Results Of The Power Test Differentiator Item Problem

Problem Number	Power Difference	Classification	Problem Number	Power Difference	Classification
1	0.17	Low	11	0.33	Medium
2	0.44	High	12	0.67	High
3	0.33	Medium	13	0.28	Low
4	0.33	Medium	14	0.28	Low
5	0.28	Low	15	0.22	Low
6	0.56	High	16	0.33	Medium
7	0.28	Low	17	0.33	Medium
8	0.28	Low	18	0.17	Low
9	0.39	Medium	19	0.44	High
10	0.28	Low	20	0.28	Low

The results shown in the table can be seen that each item of the problem has different distinguishing power results. In this study has a discriminating power with high criteria that is on a scale of 0.67 and for the lowest scale is on a scale of 0.17. For the test results of the analysis of the level of understanding of the concept of students by using three-level diagnostic questions to determine the level of understanding of students can be seen in Figure 1 below.

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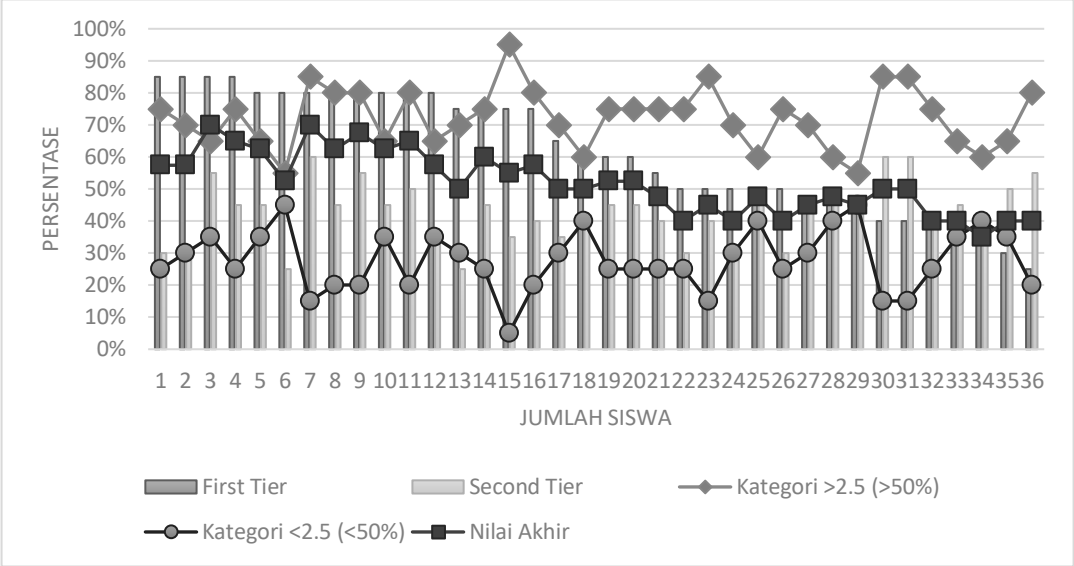

Figure 1 Student Concept Understanding

Researchers classify the answers of students in the category of understanding the concept, lack of understanding the concept, do not understand the concept, guess and misconceptions by using the interpretation of the results. Classification can be illustrated as Figure 2 below.

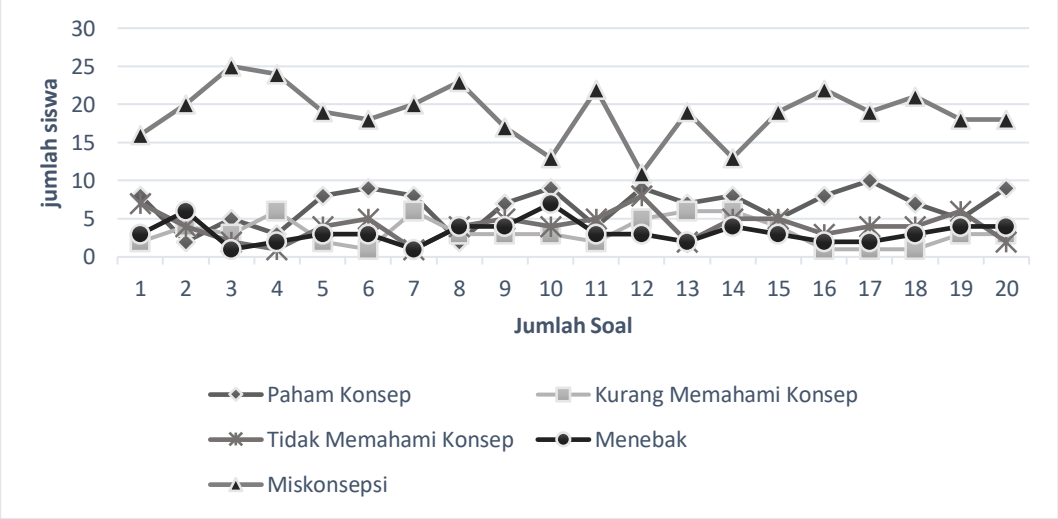

Figure 2 Number Of Students In Each Category

The activity that needs to be done after doing this is to provide a questionnaire of student responses regarding the experiment can be seen from Table 3 below.

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Table 3 Analysis Of Student Response Questionnaire

No	questions	% average	Category
1	suitability with the material studied	84%	very good
2	legibility sentence on the test questions	81%	good
3	ease of test questions to be understood	82%	Good
4	intent of the test questions easy to understand	76%	good
5	legibility or clarity of images, symbols and formulas that exist in the test questions	84%	very good
6	suitability of the number of test questions given	86%	very good
7	suitability of the processing time given	83%	good
8	concept understanding needs to work on test questions	86%	very good
9	benefits of the test to find the part of the material that has not been understood	83%	good
10	motivation to better understand the concept	83%	good
11	test questions for use on static electricity materials	81%	good

Based on the results shown in the table can be seen the average of each item of questions and for the results that can be from the average value of all questions the student's responses made a score of 83%.

- **Discussion**

Good instrument requirements include validity, reliability, objective, practical and economical (Arikunto, 2009). Item analysis also requires assessment of test questions in order to obtain instruments that have a decent quality (Sudjana, 2009). Valid Data is data that has a determination that is not far between the data studied and the data reported by researchers (Winarni, 2018). For the test instruments used to obtain validity results with a percentage of feasibility worth 89% to 100%. This result also shows if the validity obtained has very good criteria. Where in this study R_{table} used 0.329 validation of the problem is also done using *the product moment* by using approximate figures developed by person (Arikunto, 2009). And in this experimental instrument obtained four problems have invalid criteria with the value of R_{count} number 1 is 0.09, number 10 is 0.32, number 18 is 0.329 and 20 is 0.22. However, for the other 16 questions have a valid question category. The test instruments developed have reliable results with a score of 0.712 with a high category according to the interpretation of Sugiono (2013). After getting a reliable value that is sought, the next step is to see the level of difficulty of the questions used. The resultsl obtained from this study are 20 questions tested in the range of 0.3-0.7 with medium criteria and the range of 0.7-1 with easy criteria. Distinguishing power is obtained by taking both sides with a scale of 50% the highest value in the upper group and 50% the lowest value in the lower group (Arikunto, 2009). The Data that can be about the power of distinguishing the problem is 10 questions have different power low criteria, 6 questions with medium criteria and for high criteria amounted to 4 questions. From the results of the study

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obtained interpretation of the results of the analysis of the problem item can be seen in Table 4 below.

Table 4 Interpretation Of Problem Item Analysis Results

No. Problem	Validity	Reliability	Difficulty Level	Power Difference
1	Invalid	0.712	Medium	Low
2	Valid		Medium	High
3	Valid		Medium	Medium
4	Valid		Medium	Medium
5	Valid		Medium	Low
6	Valid		Medium	High
7	Valid		Easy	Low
8	Valid		Medium	Low
9	Valid		Medium	Medium
10	Invalid		Easy	Low
11	Valid		Medium	Medium
12	Valid		Medium	High
13	Valid		Medium	Low
14	Valid		Medium	Low
15	Valid		Medium	Low
16	Valid		Medium	Medium
17	Valid		Medium	Medium
18	Invalid		Medium	Low
19	Valid		Medium	High
20	Invalid		Easy	Low

From the data shown in the table shows that the questions used in this study are feasible to be used as a gauge of the level of ability of learners.

In this study also conducted the retrieval of student responses regarding the test instruments are run. It aims to find out whether the instruments developed can be accepted well or not by students. Student response is a reaction given by students in understanding something in themselves from the situation given by the educator (Fatmawati &anjarsari, 2021). Based on the results of the responses conducted by researchers obtained a good to very good scale with a value of 76% - 86% or an average of 83%. Dalah existing results can be said test instruments developed by researchers can be well received by learners. This can also be illustrated by the following Figure 3.

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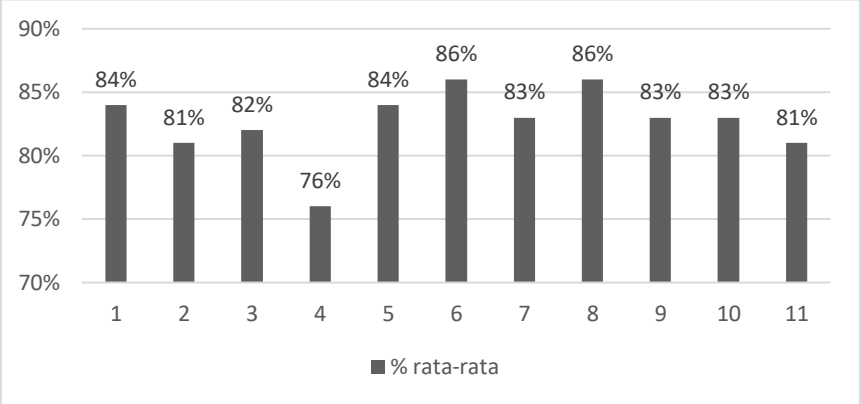

Figure 3 Average Percentage ResponOf Student Responses

Conclusion

Based on the results of data analysis of diagnostic test instruments *three tier multiple choice* on static electricity material in SMA Negeri 6 Pematangsiantar, this item is obtained with valid criteria obtained in the study has a R_{count}greater than r_{table} with r_{table} used is 0.329 or the level of = 0.05 that is with a value of R_{count} 0.43-0.65 for item problem with invalid criteria has R_{count} smaller than r_{table} used. This instrument also gets a high reliable result with a value of 0.712.

Tingkat feasibility instruments obtained in this study get the value of 20 questions made to get the results that the Twenty Questions with very good information and with little improvement made to the percentage of feasibility of each item has a value of 83.3% -100%. And for the average response rate of student responses is worth 83% with good criteria indicating that students receive good test instruments given. Therefore, the instruments developed were well received by the students in proportion to the students ' assumption of the physics test instrument in measuring the ability of students based multirepresentasion the multirepresentation of static electrical matter.

BIBLIOGRAPHY

Arikunto, Suharsimi. (2009). *Fundamentals of Educational Evaluation (Einsi revision).* Jakarta: Bumi Aksara.

Budiman, A., & Jailani. (2014). Development of Higher Order Thinking Skill (HOTS) Assessment Instrumen in Junior High School MathematicsClass VII semester 1. *Journal Of Educational Research*, 2 (1), 139-151.

de Jong, T., & van der Meij, J. (2012). Learning with Multiple Representations. In N. M. Seel (Ed.), *Encyclopedia of the Sciences of Learning* (pp. 2026–2029). Boston, MA: Springer US.

Fatmawati, & Anjarsari, P. (2021). Teacher Stimulus and ResponStudent Response in Arabic learning at junior high school level. *Journal Of Islamic Education Studies,* 13-26.

Furqon, M & Muslim. (2019). Investigating the ability of multiple representations and scientific consistency of high school students on newton's laws. *Journal of Physics*, 1-3.

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p-ISSN:2721-2718

Klein, P., Müller, A., & Kuhn, J. (2017). Assessment of representational competence in kinematics. *Physical Review Physics Education Research*, 1-18.

Kusumawati, I., Kahar, M. S., Khoiri, A., & Mursidi, A. (2019). Differences analysis understanding the concept of students between the three islands (Java, Kalimantan, Papua) through multiple representations approaches to the material of Time Dilation. *Journal of Physics: Conference Series*, 1-2.

Leone & Gire. (2006). Is Intructional Emphasis on the Use of Non-Matematical Representation Worth the Effort. *Physics EducationResearch Conference, American Institute of Physics*,0-7534-0311-2/06:45-48.

The Independent, I. K., Rofiqoh Afifatur., & Supeno (2012). Inquiry Model to improve Verbal and mathematical representation skills in high school physics learning. *Journal Of Physics Learning*. Vol 1 (2): 165-171.

Prain, V & Waldrip, B. (2006). An exploratory study of teachers' and students' use of multi-modal representations of concepts in primary science. *International Journal of Science Education*, 1843-1866. Diambil dari https://doi.org/10.1080/09500690600718294

Sinaga., Suhandi., & Liliasari. (2014). The Effectiviness of Learning to Represent Physics Concept Approach: Preparing Pre-Service Physics Teachers to be Good Teachers. *Internasional Journal of Research in Applied*, Vol. Issue 4: 127-136.

Subana. (2017). Penilaian dalam Pembelajaran Pendekatan Taktik (Assesment in Teaching Games for Undeerstanding). Proceedings Of The National Seminar On Physical Education. Sumedang:STKIPApril: the eleventh edition.

Sudjana, N. (2009). *Assessment Of The Results Of The Teaching And Learning Process.* London: Rosda.

Sugiono. (2013). *Research methodology Quantitative, Qualitative and R & D.* Bandung: Alfabeta.

Trianto. (2010). *Designing Innovative-Progressive Learning Models*. Jakarta: Prenada Media.

Winarni, E. W. (2018). *Theory and practice of qualitative quantitative research*. Jakarta: Bumi Aksara