The application of the Rasch Model to evaluate MET for the mastery of microscope concept

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Abstract. Mastery of concepts was essential for further floating into higher thought processes. This research aims to determine the level of mastery microscope concept in high school students by using the MET (Microscope Essay Test). Mastery of concepts was described through cognitive processes described from indicators of competency achievement. The instrument was developed in the test items and non-tests with a validity of 0.66, which was applied to 24 students consisting of 14 girls and 10 boys in one of Bandung's private schools. Data were analyzed using the Rasch model with the Winstep software. The results of this study show that the ability to explain and illustrate the function of the Microscope is very high, but aspects of determining the magnification of C4, the length of the C5 Microscope, and the design of the Microscope included in the category are very low. Mastery of Microscope Concepts with MET (Microscope Essay Test) analysis, based on the Rasch model, can be recommended to Educators to use learning models that can improve students' mastery of concepts.

1. Introduction
Understanding the concept is very important for students who have improved the learning process [1], students' original acquaintance can impact their knowledge of physics concepts [2]. Understanding the concept can also be interpreted as a person's ability to explain a concept in everyday language, but still to follow the concepts put forward [2], it is announced that students have agreed to their compilation understanding of the relationship between "new" knowledge and prior knowledge. The type of knowledge gained by students is conceptual understanding that can change students' perceptions about topics in physics [3]. Understanding the concepts learned by students can use and develop it further into higher thought processes [4]. Affirming a concept is an impression or idea based on relevant experience and can be generalized to form a concept. The concept of learning has a significant role in learning physics because it is the basis for discussion of phenomena Learning that successfully solves problems in a dominant scientific matter such as physics learning requires the construction of conceptual knowledge [5]. However, preliminary observations show that students are challenging in understanding physics. Physics students are complicated and dull subjects. This is in line with the results of the previous survey conducted on more than 5000 physics students in the institution which showed that students' understanding of concepts in physics learning was not satisfactory [6]. If viewed from the teacher, this can occur due to lack of preparation by the teacher when teaching both preparing learning materials, learning scenarios that do not trigger students to be active, student worksheets and learning instruments, One of them is the eyes of physics students on optical devices.
An optical instrument is a device that uses mirrors and lenses arranged according to the shape made in a microscope, which is one optical device that is composed of connectors. Microscopes are used to rotate small objects that cannot be seen directly with the naked eye [7]. Visual learning material about the Microscope, students understand objects. The object to be observed is placed on a glass preparation in front of the objective lens. Students choose shadows by bringing the eye closer to the ocular lens to get a clear image, and students must shift the secular lens. Based on the 2013 curriculum on optical material, students are expected to be able to analyze the workings of optics using the properties of reflection and refraction of light by mirrors and lenses. Students are also expected to be able to create works that use the principle of reflection and refraction of mirrors and functions. Students need strong analytical skills and a correct understanding of concepts. [8] Based on the explanation above, the researcher will consult with six indicators of achievement on microscopic material at one of the junior high schools in Bandung.

Rasch modeling can be used to measure validity and reliability directly based on the principle of probability [9]. The advantage of the Rasch model is being able to predict missing data based on integrated response patterns, being able to produce a standard error rating for the instruments used that can improve the accuracy of the calculation and calibration done with three things, namely measuring the respondent, and the need for questions [10]. The advantages of the Rasch model are very suitable for use in this study because of the compatibility of physics essay questions for students. [11] explained the Rasch model is more effective than classical analysis.

2. Methods
The method used in this research is a descriptive qualitative method. This research was conducted in one of the high schools in the city of Bandung with a sampling technique of 24 students in class XI consisting of 14 students of female gender and ten male-female students who were demanded 16-18 years of Learning Activities. The research place is right in the center of the city in Bandung with the Sundanese ethnic majority. The location of Bandung city showed in figure 1 and the the learning process presented in figure 2.

![Figure 1. Location of Bandung city](image1)

2.1 Learning process

![Figure 2. The learning process](image2)
The approved learning process, which is done once. The resulting learning kit publishes a learning scenario, student activity sheets (LKS), microscope material textbooks. At the end of the study, students were given essay tests with six questions, namely the Microscope Essay Test (MET).

At the beginning of learning, the teacher provides several saving images produced using a microscope to make a shadow on a microscope so that it can do magnification that can see microscopic objects. After that, the teacher demonstrates an experiment in the onion layer later, and the teacher motivates students by showing videos about the microscopic benefits of daily life and teaching the concept of enlarging images on a microscope. After the learning process Finally, the teacher gives Microscope essay test questions (MET).

2.2 Instruments
The instrument used to study the concepts of physics in the material used Essay Test Microscope (MET) as many as six questions in the form of essays. Microscope Essay Test (MET).

Table 1. Microscope essay test (MET)

| No | Microscope Essay Test (MET)                                                                 |
|----|-------------------------------------------------------------------------------------------|
| 1  | How is the difference in the image formed in the compilation microscope, the maximum, and non-accommodating accommodation? |
| 2  | Describe the process of making shadows on a microscope when the eyes are maximum accommodating, and the eyes are not accommodating |
| 3  | What is the process of collecting shadows based on your observations? Draw based on the activities you have done |
| 4  | Distance with a microscope 3 cm and eyepiece with a distance of 8 cm. If the distance from the eyepiece to the objective lens is 30 cm, calculate the total microscopic magnification at the time of the eye without accommodating |
| 5  | Distance with a microscope 3 cm and eyepiece with a distance of 8 cm. If the distance from the eyepiece to the objective lens is 30 cm, calculate the total microscopic magnification at the time of the eye without accommodating. A microscope with an objective lens and an ocular lens, each is focusing 1 cm and 2 cm. The image produced from the objective lens is at a distance of 15 cm from the ocular lens. Total magnification and length of the Microscope if the eye is maximum accommodation |
| 6  | Reza and his classmates are required by the teacher to assess simple experiments about optical devices from the division made by Reza to get parts to do experiments about simple microscopes. In this task, Reza is required to erroneously erect a simple microscope consisting of two positive points with a distance of 10 mm and 100 mm, respectively, with a distance of 12 mm in front of the object. Which is designed later will get maximum results |

for some questions presented as many as 6 questions in the form of essays where questions number 1,2,3 questions are in the student worksheet then questions number 4,5,6 are given at the end of learning. These questions are about the concept of shading in a microscope.

3. Results and Discussion
Figure 3 is the result of the average number of scores obtained by whom per each question. Figure 3 is the result of testing the physics learning instruments on the microscope material on each indicator. Achievement on indicator 1 shows a percentage of 91% with the GPA indicator 1, explaining the function of the Microscope in this indicator students are given questions about the function of the Microscope, for this indicator actually includes an elementary problem, but there are still some students who answer not specific so they cannot achieve 100 %. In the second indicator the results showed 58% with the GPA 2 indicator, illustrating the formation of shadows on the Microscope more than 50% of students were able to answer correctly on the second indicator, but there were still many students who answered incorrectly because students only explained the formation of shadows on the Microscope only at the beginning of the shape and the resulting shadow is produced. In the third indicator, there is a percentage of 75% with a GPA indicator 3, which is estimating the shadows formed on the Microscope.
when the eye is maximum accommodating, and the eye is not accommodating maximum. Who has not been able to reach the 3rd indicator because this teacher does not teach how to draw a shadow correctly. In the 4th indicator students are asked to determine the magnification of the shadow on the Microscope there is a percentage of 50% this is aimed at only 12 students who are able to answer correctly on this indicator 4 is caused because the results of student answers only to determine the size of the objective lens and ocular lens on Student microscopes do not determine how much magnification they are. The 5th indicator is that students are asked to determine the length of the Microscope there is a percentage of 41%, which means more students answer wrong to the 5th indicator because this is because when students answer questions for the 5th indicator the students are only able to finish up to determine the magnification of the Microscope not to determine the length of the Microscope. Then on the 6th indicator, that is, designing the design of shading in a simple microscope, the percentage of 37% when working on the 6th indicator students have difficulty in describing shadows clearly beside the teacher also does not teach in advance how to describe.

![Figure 3](image_url)

**Figure 3.** Results of the percentage of questions on each indicator.

### 3.1 Analysis of Student Ability

Figure 4 shows how many students who have good abilities are grouped based on the average value of students and the level of difficulty of the items. Data about the ability of students or abilities obtained by only 11 students who have good ability means that there are still more students in the category of low ability.
3.2 Microscope Essay Test (MET) analysis

In the analysis of this problem, it is taken by selecting the percentage of the highest and lowest scores found in question number 3 and number 6. The highest presentations are in problem number 3 by 75% and the lowest in question number 6 is 37%. Figure 5 is the result of correct student answers.

![Figure 4. Analysis of student ability](image)

**Figure 4.** Analysis of student ability

![Figure 5.](image)

**Figure 5.** (a) Original student figure of the incorrect student answer; (b). Translate student figure

In question number 3, students were asked to estimate the image formed on the Microscope that was accommodated to the maximum of the image, indicating that the student was able to estimate the image formed on the Microscope. But there are still 35% of students who have not been able to estimate shadows on the Microscope correctly. Figure 10 is one of the results of students' answers that have not been answered correctly.
Figure 6. (a) Original student figure of the correct student answers; (b) Translate students’ figure

In question number 3 shows, there are still students who have not been able to answer correctly. This is because the teacher does not teach how to draw a shadow properly. Then Figure 7 is the result of correct student answers to question number 6 from the results of the percentage of questions number 6 entered into the most difficult category to be done by students by only 37% of students who can answer correctly following an example of one of the correct student answers.

Figure 7. (a) Original student figure of incorrect student answer; (b) Translate student figure

In question number 6 students are asked to design a shadow formation design under a simple microscope.

Figure 8. (a) Original student figure of the correct student answers; (b) Translate student figure
The results of question analysis number 6 show that there are still many students who have not been able to design a simple microscope design with a percentage of 63%. This is because the teacher does not teach how to draw an image first and determine the formation of shadows produced by the Microscope correctly.

4. Conclusion
The number of students who are still low 11 students are not yet in good ability. Then for the results of the reliability of the test is a reliability test of 0.66 which is included in the category enough. In the learning process, students must first be trained to draw in shapes made with a good microscope. Because students have difficulty drawing shadows made by the Microscope besides when students ask to make simple designs in making microscopes there are still many students who find it difficult to draw them.

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