Profile of student’s understanding in Kinetic Theory of Gases

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Abstract. Students in eleven grade had a different style for answering the physics problems. They could do anything to solve the problem. The way they thought and revealed it into the answer in many styles could be used as a data to know their conception. One of the sub-chapter in physics was the effective velocity of gases. It included in Kinetic Theory of Gases. It was one of the most difficult scientific theories to accept. This research aimed to identify student’s understanding in effective velocity of gases problem. The research was qualitative research. It was taken place at MAN Yogyakarta I in semester two on grade eleven. The obtained datas were collected by test sheet that contained of essay form. The respondents were all of the students in XI MIA 3. The data was analyzed by quantitative analysis using rubric of scoring in essay test and it contained of two problems. The results were the students had resolved the test and it was divided into three categories which are high 10.42\%, medium 29.17\%, and low 50.00\%.

1. Introduction

Process of learning is one of an activity to do the curriculum to achieve the purpose [1]. Learning progressions or learning trajectories can provide a guiding framework for the process of formative assessment, one of the most powerful current educational practices in terms of improving student learning [2]. Physics, still being reputed through mathematical equation, number, and a hard quantification [3]. The result of this study supposed to be used as a reference for the teachers to reveal the profile of student’s understanding. The research has been conducted by some experts such as teacher’s understanding of the concept was far from complete and that teachers were more likely to overestimate pupils’s knowledge [4]. Explanations about findings and implications for instructional design are discussed in the conclusion [5]. Student responses were very positive prior to fieldwork and became more positive as a result of the field experience [6]. The study revealed significant interaction effects among the predictors and provides more accurate interpretations of the findings [7]. Conceptual framework could overcome the problems to enable a better shared understanding of student engagement [8]. Describing the elements and exploring the theoretical foundations of engagement framework [9]. Changes in students’ conceptions may be related to their teacher’s knowledge of the content, attitudes toward science, and understanding of conceptual change [10]. The study attempts to contribute to the growing body of investigations that aim to understand the process of the comprehension of natural phenomena [11].
From the result of the research, we can conclude that the way student answers the problem is still lack of completeness. The causal factor such as student’s understanding, student’s conception, and teacher’s attitude can be the main reason of the way student resolves the problem. This research aims to identify student’s understanding in many ways so that we can divide it into three categories.

Student’s answer in resolving effective velocity of gases is one of the method to get the student knowledge or understanding about the material and how far they understand about it. The way they think and reveal it into the answer in many styles can be used as a data to know their understanding. The students’ concept understanding is influenced by the initial concept, their perception on the concept, and the deepening of accepted concepts. Conception is the initial information that students have, before the learning activities. Perception is the basic for building knowledge. If the student's perception is incorrect, it can cause a misconception [12]. The student’s perceptions are important to building knowledge. It can cause incorrect conception [13]. To avoid the negative effect that can influence student’s conception, we should keep trying to do the proper method to the students. So it is necessary to choose the right learning model or strategies in deepening the concepts. By knowing the conceptions and perceptions that students have, teachers can choose the right method to improve learning outcomes [13]. A sub-material called effective velocity of gases can be observed as a main theme in this research to analyze the student’s answer in resolving the problem in it.

Effective velocity of gases is a part of kinetic theory of gases in physics. The kinetic molecular theory has been included in middle school curricula worldwide for many years, nonetheless, numerous studies have demonstrated that even following relevant instruction, it is one of the most difficult scientific theories to accept [14]. Since effective velocity of gases is a part of kinetic theory of gases material, it is also being the difficult part to be understood by the students. We designed the rubric as a guideline to check the student’s answer off. Their answer can be compared one another based on the rubric to divide to several categories.

2. Research method
The research method used descriptive qualitative. Research subjects are the students of grade eleven in MAN Yogyakarta I, Indonesia, as many as 24 students in class of MIA 3. Data was collected using conceptual test of effective velocity of gases accompanied by the students’ argumentation of their answer.

3. Result and discussion
Conceptual tests are given to the 24 students in class of MIA 3. The test is being done to get the various kind of student’s answer. The students have understood the concept because they got the treatment as well before, so we expect they can answer to resolve the problem in effective velocity of gases as well as they got the lesson. Several studies relating to student’s understanding of the kinetic particle theory at various levels have been documented since 1970s. Collectively, the research has shown that student’s intuitive ideas about scientific concepts following instruction change to acceptable scientific conceptions only to a limited extent [15]. The ideal gas law and the kinetic theory of gases are covered in many introductory physics and chemistry courses and, at a somewhat more advanced level, in thermal physics courses [16]. The problem of effective velocity of gases and the rubric can be checked out below in Table 1.

| No. | Problem                                           | Rubric                                         | Score |
|-----|---------------------------------------------------|------------------------------------------------|-------|
| 1.  | Hellua is observing a closed room which had pressure $3.2 \times 10^5 \text{ N/m}^2$, Hellua wants to get the effective velocity of every $\beta = 6 \text{ k g/m}^2$, $v_f = \ldots$? | Effective velocity of gases:                   | 2     |

Table 1. Rubric of effective velocity of gases problem.
The problem consists of two problems. The students are intended to solve Hellua and Silvia’s problem. We got 24 answers from the students, and it is in a various way.

Student’s answer is presented in figure 1 below.

![Student's answer](image_url)

**Figure 1.** The student’s answer that showed in a nearly complete way as well as a rubric.
Based on all of student’s answer, here’s the resume of the explanation on table 2 below.

**Table 2.** Amounts of students that answering in those level of scores.

| Score | Students |
|-------|----------|
| 6     | 3        |
| 5     | 9        |
| 3     | 12       |

The percentage is shown in table 3 below.

**Table 3.** Percentage of student’s answer categories.

| Categories | Percentage (%) |
|------------|----------------|
| High       | 10.42          |
| Medium     | 29.17          |
| Low        | 50.00          |

The students that doing the answer in a reasonable way lay on a high position, but the amount of student is just under the teacher expectation. The low position takes students the most. Due to their habit of answering the question, they choose to answer it instantly and stick to the main answer without mentioning the part that could affect their scoring. The nature and prevalence of the errors
made by the students motivated to probe more deeply into their understanding of the macroscopic variables of pressure, temperature, and volume.

3.1. Profile of high student’s understanding
The student tends to do the common way at answering the problem which is in series. There are part of variables that foreknown, the question (or variable that have to be resolved), and the result or process to answer the problem. However, only three students (for Hellua’s problem) and two students (for Silvia’s problem) who resolved the problem in that proper way. For Hellua and Silvia’s problem, the students revealed that they used to answer the question chronologically by writing the written quantities of the problem, knowing the inquired quantities, and using the equations step by step to find the answer and the conclusion. It makes light of the student’s thinking pattern about answering the essay problems.

3.2. Profile of medium student’s understanding
They do the same process as a rubric, nearly. However, they do not finish the process until the end. Their answer is just stuck in that way. Nine students do that thing to resolve the problem of Hellua, whereas for Silvia’s problem it’s about ten students do the same way. Even though it seems a good beginning at the answering due to it includes the foreknown variables and the question, the process to resolve the problem does not say so. They abandon the unit and do not mention the conclusion. According to the students by interviewing them, they thought that by writing the equation and correlating it to another equation is just enough to solve the problem even though they did not find the final answer.

3.3. Profile of low student’s understanding
Most of students do the uncompleted step of answering. They actually know how to resolve but they are too reluctant to complete the step as well as the rubric. So, the process just ended up that way. Even though the actual answer is true, but it affects the scoring. They only get the score as they deserve. Twelve students do that way both in Hellua’s problem and Silvia’s problem. By interviewing the students, we know that they’re just reluctant to write down the available quantities and also the unit. They thought it is such as wasting time to write down the quantities completely. They just want to solve the problem quickly and instantly without writing the details.

4. Conclusion
Based on the result and discussion, it can be concluded that in answering to resolve the problem, not all students do the same exact thing as well as the rubric. There are so many difference at answering the problem. In this research, student’s answer is completely identified into three categories. That categories are high (10,42%), medium (29,17%), and low (50,00%). The specific characteristic for each category seems by the way students answer the question for every step.

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