Implementing a four-tier diagnostic test to assess elementary school students’ on electricity magnetism concept

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Abstract. This article reports on the implementing a four-tier test diagnostic instrument on electricity magnetism concept, which has not been defined in the literature. It is an enhanced understanding of the two-tier test substances. The four-tier diagnostic test was focused on electricity magnetism concept. It was measured to 40 elementary school students. They were correctly trained on the preceding topics. The substantial corporate of the respondents was established to have an unfortunate kind and misconceptions of the subjects tested. We have already described that the test was able to investigate and categorize students into student conception of electricity magnetism concepts. Research result with four tier tests showed scientific conception 8.85%, which was likely to have misconceptions 63.4%, and the students were lack of knowledge the concept of 25.2%, and had an error amounted to 2.55%. The elementary school students’ inclined to be unwell aware among what they diagnosed and what they do not diagnosed. It might be determined that a Four-Tier Diagnostic Test which has previously been established be able to assess elementary school students’ conception on electricity magnetism concept. The constructed test has shown effectively to identify primary students’ conception

1. Introduction
The source of this learning is a constructivist process that is punished in the trust that what a student previously tells is a key element in accountable the results of knowledge. Students are delivered with openings to improve different kindnesses through the educator performing as an organizer of knowledge slightly than as a source of understanding. Misconceptions are problematical students on abstract science concept. Students are taught as if they had no prior ideas and experiences about science concept being studied previously. However, students’ minds are not empty; they are full of prior ideas and have several daily life experiences related to scientific phenomena before coming to science course [1]. Students may have both scientific ideas and some alternative conceptions in science concept [2]. Alternative ideas can be as alternative frameworks [3] or misconceptions [4]. Misconceptions are obstacles to change with scientific ones and students may reject or accepting new ideas [5] and they are obstacles for students in learning and to make thoughtful of some concept in science. Students’ alternative conceptions in science
can be origin from some sources; such as prior knowledge, daily life experiences, language, culture, teacher, textbooks and instruction [1].

Misconceptions can resist the assimilating process new knowledge; the misconceptions must be assessable as soon as possible. To identify the subsistence of misconception is essential instrument that can expose the state of conception owned by student. The state of conception is strongly related to the student's conception belief, the instrument to diagnose the state of conception supposed by the student is usually a collection of the conception test and the level of conception belief. Some researchers have developed multiple-choice conception tests in various formats, such as two tier test format [6], three tier test format [7], and four tier test format [8]. Three tier tests were developed to two tier tests by adding a tier of reasoning options. Four tier tests were developed to additional a tier of choice for reasoning beliefs.

The scientist’s implementation on Four Tier Test format to identify beginning of pre-service elementary school teachers to the conception of electricity magnetism in science concept. Four Tier Test format increase was transformed from the structure of instrument established by Vatansever that completed up the instrument in format of the three-tier test kind, while the progress of every tier has been advanced and accumulated in first tier of some average assessments as in [9-12]. Three Tier Test prepared into three levels (tiers), specifically: the first tier to the average investigation in the form of multiple choice with five varieties, the second tier is assumed a blank for an explanation of the selected answer and third tier level of confidence rating answers, specifically: very confident, not confident and do not know.

2. Method
In this study, constructing conception test in four tier test format on electricity magnetism utilized 3D-11 model of developing (Define, Design, Develop and Implementation) [13]. The step of define was identify misconceptions on concept of electricity magnetism, the design step was contents of each tier in the four tier test format, contracting the conception test based on the design that has been made at the design stage was develop stage. Using four tier tests developed in diagnosing primary school students’ conception in Pekanbaru Riau was implementation stage. The sample of this study was 40 students who have studied electricity magnetism concept. Categorizing conception that belongs to the students was used the guideline to classify in categories of Scientific Conceptions (SC), Misconceptions (M), Lack of Knowledge (LK) and Error (E) [13,14].

3. Result and discussion
The four tier diagnostic test has been developed to diagnose the elementary school students’ conceptions on electricity magnetism concept. Research utilized Three-D and one-I developing model (Define, Design, Develop and Implementation). For comprehensive analysis, we are going to explain follows.

3.1. Define
The Four Tier Diagnostic Test Items on electricity magnetism concepts has been preliminary to be recognized in define step. Electricity magnetism is an abstract and microscopic concept. Hence, the four-tier test format was developed to diagnose conception test. This instrument needs to be developed, we could not tell apart the only one self-confidence rating to the two tiers (the first associated several choices and the second tier related to the reasons choice in the first tier). Three-tier test has some weakness to analyse students’ conceptions in the confidence rating [14-16].

3.2. Design
In the next level of 3-D + II, we have developed the four-tier diagnostic test items on electricity magnetism concepts. The scheme of these instruments created in the several choices and the explanations as shown in figure 1.
4. Develop

The four tier diagnostic test format involved four stages, these are multiple choices in first tier, confidence rating related to the first tier, some reasons for comprehensive the response in the third tier and confidence rating associated to the third tier in the fourth tier. The sample of instrument conception test in the four tier format in the figure 2.

Question:
Object P is closer to a Q object made of plastic material that has been rubbed with wool fabric. Both objects attract each other, it can be concluded that:

Answer Choice (Tier I):
A. P and Q are positive charge
B. P and Q are negative charge
C. P is positive charge and Q is negative charge
D. P is negative charge and Q is positive charge

The first Confidence Rating Scale (Tier II)
A. Alternative option if “sure” over the selected answer
B. Alternative option if “not sure” over the selected answer

Reasons (Tier III):
A. Alternative choice of first reason
B. Alternative choice of second reason
C. Alternative choice of third reason
D. Other reasoning

The Second Rating Scale (Tier IV)
A. Alternative choice if convinced of the reasoning answer selected
B. Alternative choice if unsure of the chosen reasoning

Figure 2. Sample product of four-tier test about electricity magnetism.
5. Implementation
In implementation stage has been implementing conception test that has been developed. Exploration data was the diagnostic effect of a profile elementary school student’ conceptions in the academic year 2017/2018. Quantitative data were articulated in percentages while qualitative data was attained significant data. To categorize the state of student conception based on four tier test [13-15], the data have been analyzed as shown in table 1.

Table 1. The category of conceptions through four tier diagnostic test.

| No | Category                        | The first Confidence Rating Scale (Tier II) | Reasons (Tier III) | The Second Rating Scale (Tier IV) |
|----|--------------------------------|--------------------------------------------|--------------------|-----------------------------------|
| 1  | Scientific Knowledge (SK)       | Correct Sure                               | Correct Sure       | Sure                              |
| 2  | Lack of Knowledge (LK)          | Correct Sure                               | Correct Not Sure   | Not Sure                          |
|    |                                | Correct Sure                               | Incorrect Not Sure | Not Sure                          |
|    |                                | Correct Not Sure                           | Correct Not Sure   | Not Sure                          |
|    |                                | Incorrect Sure                             | Correct Not Sure   | Not Sure                          |
|    |                                | Incorrect Not Sure                         | Incorrect Not Sure | Not Sure                          |
| 3  | Misconception (M)              | Correct Sure                               | Incorrect Sure     | Sure                              |
|    |                                | Correct Not Sure                           | Incorrect Sure     | Sure                              |
|    |                                | Incorrect Sure                             | Incorrect Sure     | Sure                              |
| 4  | Error (E)                      | Incorrect Sure                             | Correct Sure       | Sure                              |
|    |                                | Incorrect Not Sure                         | Correct Sure       | Sure                              |

Table 2. Students’ conceptions profile on electricity magnetism.

| Number of concept | M (%) | LK (%) | SC (%) | E (%) |
|-------------------|-------|--------|--------|-------|
| 1                 | 50    | 22     | 13     | 15    |
| 2                 | 40    | 28     | 19     | 13    |
| 3                 | 38    | 49     | 13     | 0     |
| 4                 | 40    | 60     | 0      | 0     |
| 5                 | 45    | 35     | 18     | 2     |
| 6                 | 60    | 30     | 10     | 0     |
| 7                 | 55    | 25     | 20     | 0     |
| 8                 | 70    | 10     | 20     | 0     |
| 9                 | 80    | 5      | 15     | 0     |
| 10                | 90    | 5      | 5      | 0     |
| 11                | 100   | 0      | 0      | 0     |
| 12                | 100   | 0      | 0      | 0     |
| 13                | 80    | 20     | 0      | 0     |
| 14                | 80    | 10     | 10     | 0     |
| 15                | 40    | 40     | 15     | 5     |
| 16                | 40    | 60     | 0      | 0     |
| 17                | 65    | 25     | 10     | 0     |
| 18                | 65    | 10     | 9      | 16    |
| 19                | 60    | 40     | 0      | 0     |
| 20                | 70    | 30     | 0      | 0     |
| Average           | 63.4  | 25.2   | 8.85   | 2.55  |
Table 2 shown that elementary school students’ conception remained in anxiety. This is outstanding to actual little percentage about 8.85% of students who scientific knowledge (SC). Besides, students who have misconceptions considerable developed than the students who scientific knowledge of electricity magnetism, that is 63.4% comparative to 8.85%. The data that mindfulness of students when they learn electricity magnetism concept in the primary school level in the concept science to modification from the misconceptions to the scientific conceptions has previously conferred in Kaniawati et al. [17].

Table 2 shows that the number of primary school students who misconception on each label of electricity magnetism concept was quite a lot, even though they have followed the study of the concept of electricity magnetism in science classroom. This occasion supposedly has something to do with the lessons learned by teachers cannot provide thoughtful in the minds of the students.

The result of learning observation shows that teaching and learning implementing traditional method of information has not companionable with the character of the microscopic electricity magnetism material and requires visualization media which can model the atomic phenomena into macroscopic that can be observed by the eye [1].

6. Conclusion

Has been successfully constructed the electricity magnetism conception test in four tier test format. The constructed test has shown effectively to identify primary students’ conception. This was explored by developing instrument test in differentiating students who have a scientific conception, experiencing misconceptions and lack of knowledge. From this study, teachers need constructing media visualisation to change their conception and reduce students’ misconceptions.

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