How are misconceptions about material discontinuation by gender in elementary school teacher candidates?

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Abstract. This study wishes to conclude the gender differences in conceptions about the discontinuous nature of the material in potential elementary school teacher candidates. Exhausting descriptive-qualitative research method, the data were composed of the third-grade school teacher candidates of Sumedang Regional State University, with 84 participants (20-21-year-old). Instruments used in the usage of multiple-choice four-tier, questionnaires, and interview. The upshots of the tests are then treated by evaluating the school teacher candidate answers for each item and gathered by four-tier categories combined with the questionnaire and the interview. The upshots of this study indicate that the highest average percentage of school teacher candidate answers, be it female or male school teacher candidates experiencing ‘misconception’. Consequently, it can be supposed that the conception of the discontinuous nature of the material on the third-grade school teacher candidates is still very low. As a final point, countless school teacher candidates are incapable to understand the material well.

1. Introduction

In science, to recognize all scopes of an inferior basis of a new concept is fatefully important in learning the concept [1-2]. In the route of mastering the concept of science knowledge, students commonly have exertion understanding the concept of science knowledge which then leads to misconception. Core explanations of misconceptions can be registered as; student (lack of personalize knowledge, preconceptions, shortage of motivation and interest, spending day-to-day language in scientific issues), teacher (inadequate substance knowledge, ordering of concepts, generous more attention to details) and textbook factors [1,3].

Misconceptions besides arise in the concept of the particulate state of an object or can be identified by the discontinuous nature of matter. The particulate nature of matter is recognized in science education standards as one of the indispensable concepts [4-5]. Thus, many of them have difficulty in understanding the material about the nature of the particle. On behalf of the particulate nature of matter, students have a mental model that differs from the science concepts since students have only macroscopic involvement for the matter [4-6]. This is in stripe with the upshots of the discontinuous material test accompanied on prospective elementary school teachers. Numerous of them do not
understand the concept of free space of particles in solids, liquids, and gas objects.

![Figure 1](image_url)

**Figure 1.** A composition of the particle in solid, liquid body, and gas objects.

Figure 1 is an image showing the particle structure of any solid, gas object, and liquid body. Discourse of particles, elementary school teacher candidates must furthermore recognize the parts of the particle itself. The integer of particles is communicated in entities of moles. One mole of the ingredient comprehends the integer of particles equal to the integer of particles in 12.0 grams of isotope C-12 i.e. $6.02 \times 10^{23}$ particles. Voluminous elementary school teacher candidates do not grasp it in a microscopic viewpoint.

Ability of the student microscopic involvement for matter is influenced by the gender they have. Girls, however, report being more harassed in their science classes than boys [7-8]. Hence, it can be said that gender differences can impact the mastery of the concepts presented through student learning outcomes [9]. Disappearance from the preliminary findings, the focus of this study aims to find out how the impact of gender on the conception of the discontinuous nature of the material at the third-grade student of elementary school candidates. The upshots of this study are probably to be a consideration for related research that aims to expand student conceptions on the discontinuous nature of the material.

2. Method

This study uses the qualitative-descriptive method that purposes to observe students without generous action to the subject then the results are prevailing in a forthright and truthful way. The subject of study is a third-class student of one of the state universities in Bandung area which amounted to 38 participants (20-21-year-old). They are 19 boys and 19 girls who have prior knowledge about material discontinuation.

Instruments used in the usage of multiple-choice four-tier, questionnaires, and interviews. The test is a four-tier multiple-choice of 7 items where each question characterizes each indicator. The upshots of the test are evaluated by point of question by observing at the answers to the questions, explanations, inscription pictures or symbols and sureness levels, then classified into one of the four-tier categories consisting of “Understand”, “Partial Understand”, “Misconception”, “Not Understanding”, and “Uncode”.

3. Results and discussion

Figure 2 appearances the average results of elementary school teacher candidates conception tests on the discontinuous nature of the material for each indicator or item as follows.
3.1. **Knowing the concept of the constituent particles in solids**

In item 1, many of elementary school student candidates are in the category of "Partial Understanding", as shown in figure 3. Based on that figure 3, we know that most of male students in the category "Understand". Therefore, it can be said that the mastery-concept of male students of elementary school teacher candidates is better than male students of elementary school teacher candidates. There is study which says that man represent 54 % of all earned doctorates in the biological and biomedical sciences and 48 % of all earned medical degrees since 2012 [10-11].

3.2. **Knowing the concept of the constituent particles in a liquid**

Based on the item 2, many of their answers are in the "Understand" category. If item 2 of the elementary school teacher candidate answers are seen based on the gender difference, then the upshot is like figure 4. Based on figure 4, it is known that 31.57% or 12 male students are in the category of "Understand". Based on interviews and questionnaires data, many of elementary school teacher candidates are more aware of the existence of particles in a liquid [12], because they already know when in high school. Thus, it can be said that the ability of male students of elementary school teacher candidates in item 2 is better than female students.
3.3. **Knowing the concept of the constituent particles in gas objects**

On item 3, many of the elementary school teacher candidates are in the category of "misconception". If item 3 of the elementary school teacher candidates answer are seen based on the gender difference, then the upshot is like figure 5. Based on that figure 5, the "Understand" category has 7.89% or 3 male students of the elementary school teacher candidates who can understand the problem. Based on the results of interviews, many of the elementary school teacher candidates are convinced that there is no particle in the gas. It shows that gases are some of the chemistry subjects that students commonly fail to understand [13]. Thus, it can be said that the male's mastery-concept is better than female students of elementary school teacher candidates.

![Figure 5. Test upshot based on gender in item 3.](image1)

3.4. **Knowing the concept of particles contained in solid objects do vibration**

In question 4 the dominance of student answers is on the categorized "Misconception". This is supported by interview data which says that they are never learned about it before. If item 4 of the elementary school teacher candidates answer are seen based on the gender difference, then the upshot is like figure 6.

![Figure 4. Test upshot based on gender in item 2.](image2)
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Based on that figure 6, it shows that female students of elementary school teacher candidates have better mastery-concept than male students. It can be happened because most of the teachers often avoid chemical themes due to a lack of knowledge, interest, and confidence [14].

3.5. Knowing the concept of free space of particles in solids
In item 5, the answer of the elementary school teacher candidates is dominated by the "Misconception" category. If item 5 of the elementary school teacher candidates answer are seen based on the gender difference, then the upshot is like figure 7. In this case, many female students are in the category of "Partial Understanding". Most of the students think that there are no spaces between the particles of a solid [15]. This analysis shows that in item 5 the conception of female students of elementary school teacher candidates is better than the conception of male students of elementary school teacher candidates.

3.6. Knowing the concept of the free space of particles in a liquid
In item 6, many of the elementary school teacher candidates responded with the answers which categorized as "Misconception". If item 6 is viewed in terms of gender differences, the result is like the figure 8. There is a male student of an elementary school teacher who has a good mastery-concept. Most of the students perceive that there are no gaps between the particles of a liquid [15]. Therefore, it can be said that in item 6 is dominated by male students of elementary school teacher candidates.
3.7. Knowing the concept of free space of particles in the gas object

In item 7, more than half of the answers from elementary school student candidates are in the "Misconception" category. Most of them wrong in answering the third tier that asks students to write down a gas name and its symbol. If item 7 is viewed in terms of gender differences, the upshot is like the table 1.

Table 1. Test upshot based on gender in item 7.

| Category       | Understand | Partial Understanding | Misconception | Not Understanding | Uncode |
|----------------|------------|-----------------------|---------------|-------------------|--------|
|                | 2.63       | 36.84                 | 42.10         | 15.78             | 2.63   |
| M F            | 0 1        | 6 6                   | 12 6          | 0 4 1 2           |
| M F            | 1 2.63     | 15.78                 | 15.78         | 31.57 15.78       |

Based on that table 1, upshot of item 7 shows that there is a female student of elementary school teacher candidates in “Understand” category. Most of the students perceive that there are no gaps between the particles in a gas object e.g. [15]. Hence, it can be said that in item 7 the ability of female students of elementary school teacher candidates is better than male.

4. Conclusion

Almost in all indicators, students of elementary school teacher candidates have the misconception. Based on the percentage of gender in each item, it can be said that the conception of the discontinuous nature of the material on male student of elementary school teacher candidates are better than that of female student of elementary school teacher candidates. Therefore, it would be better to do further research on the relationship between gender differences with students' understanding of concepts.

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