How Is the Students’ Concept Mastery in Terms of Gender Differences? The Effectiveness of Probing Prompting Learning Model

Ricadesta Amalia¹, Trisnaningsih², C Anwar³, A Thahir³, N Lutfiana³, N E Susilowati³, I S Wekke³, A Saregar*¹

¹SMKN 4 Bandar Lampung, Indonesia
²Universitas Lampung, Indonesia
³Universitas Islam Negeri Raden Intan Lampung, Indonesia
⁴STAIN Sorong, Indonesia

*antomisaregar@radenintan.ac.id

Abstract. The relationship between gender and educational outcomes is still very interesting to talk about. This study aims to test the effectiveness of the probing prompting learning model on the physics concept mastery, the effect of gender on the physics concept mastery and examine the interaction between the application of the probing prompting learning model and discovery learning in terms of gender on the students' physics concept mastery. The research method used is quasi-experiment with a post-test only control group design. The research sample consisted of two classes chosen by purposive sampling technique; class VIII A as the experimental class and class VIII B as the control class. Data collection techniques used were test to obtain the data of concept mastery. The hypothetical test used was two-way ANOVA. The conclusions from the results of this study are: (1) The probing prompting learning model is more effective than the discovery learning model on students' physics concept mastery, (2) gender affects the students' physics concept mastery, and (3) there is no interaction between the application of the probing prompting learning model and discovery learning in terms of gender toward the students' physics concept mastery.

Keywords: Gender, probing prompting learning model, concept mastery

1. Introduction

A topic on the relationship between genders and educational outcomes is still very interesting to talk about. Several research results reveal that gender differences affect differences in views and patterns in overcoming problems so that it affects the differences in learning outcomes [1–3]. One learning achievement that is influenced by gender is the concept of understanding and mastery [4–7].

Many studies have examined the relationship between genders and learning outcomes. Among other things, gender influences differences in the speed of students' concept understanding [8, 9], creative thinking abilities [10], self-efficacy, and metacognitive abilities [11].

Good mastery of concept can also be influenced by the learning model used [11–14]. Several learning models and approaches that have been proven to be effective in improving students' concept mastery include the scientific approach [16], STEM [9] guided inquiry model [17], generative learning
model [18], advance organizer [19], ARIAS model, problem-based learning [20], jigsaw cooperative learning model [21] and probing prompting model [19, 20]. The probing prompting learning model guides students to be able to construct concepts, principles, and knowledge by allowing the teachers to ask a question and guide the students in solving problems [24]. The probing prompting model engages the students to be active in learning and guides students to solve a problem by leading them with a question so it is expected that mastery of concept and learning outcomes could increase [25].

Several previous studies have shown that the probing prompting learning model is effective in improving student learning outcomes [21, 23–26]. However, no research examines the effectiveness of probing prompting learning model on concept understanding in terms of gender differences. So, it is important to conduct research that proves the effectiveness of probing prompting learning model on concept understanding in terms of gender differences.

2. Method

The research method employed is quasi-experimental with a post-test only control group design. The populations of this study were eighth-grade students of SMP Negeri 1 Sumberejo. The sample consisted of two classes determined by purposive sampling technique. Class VIII A (Experimental Class) was taught using the probing prompting learning model and VIII B (Control Class) was taught using the discovery learning model. Data collection techniques used were test to get data on concept mastery. The research hypothesis testing was calculated using two-way ANOVA with a 2x2 factorial design [30].

Table 1. The 2x2 Independent Factorial design

| Free Variables (A) | Learning Learning                                      |
|--------------------|--------------------------------------------------------|
|                    | Probing Prompting Model (A₁)                           |
|                    | Learning Discovery Learning (A₂)                       |
| Gender             | A₁ B₁                                                   |
| Male (B₁)          | A₂ B₁                                                   |
| Female (B₂)        | A₁ B₂                                                   |
|                    | A₂ B₂                                                   |

Table 1 contains hypotheses regarding the influence of learning models, gender differences, and interactions between models and genders.

Before testing the hypothesis, the normality test and the variance homogeneity test were performed. To test the effectiveness of the probing prompting model, the effect size formula was used [31].

\[ d = \frac{m_A - m_B}{\left(\frac{sd_A^2 + sd_B^2}{2}\right)^{1/2}} \]

By:
- \( d \) = Effect Size
- \( m_A \) = Average gain of the experimental class
- \( m_B \) = Average gain of the control class
- \( sd_A \) = Standard deviation of the experimental class
- \( sd_B \) = Standard deviation of the control class
The research process is depicted in the following chart:

**Figure 1. The Research Process**

3. **Result and Discussion**

The data obtained in this research was the concept mastery data. The data was obtained from the test given to 32 students in each class after the application of the probing prompting learning model and the discovery learning model. The averages total score in the study are shown in Table 2:

| Results     | Class       | Male | Female |
|-------------|-------------|------|--------|
| Pretest     | Experimental| 45   | 49     |
|             | Control     | 55   | 49     |
| Posttest    | Experimental| 80.5 | 76     |
|             | Control     | 76   | 71     |

Table 2 shows that the concept mastery of the experimental class is better than the control class. Hypothesis testing was done using the parametric test two-way ANOVA (analysis of variance) with 2 x 2 factorial design in SPSS20. If the P-value > alpha 0.05, then H₀ is accepted = no difference or effectiveness. If P-value < Alpha 0.05, then H₀ is rejected = no effectiveness. If P-value > alpha = 0.05,
then $H_0$ is accepted = no interaction. If P-value $<\alpha = 0.05$, then $H_0$ is rejected = no interaction. The summary of the results of two-way variance analysis is shown in Table 3:

Table 3. The Results of ANOVA Test

| No | Hypothesis 2x2 | Significance of Concept Mastery | Result       |
|----|----------------|---------------------------------|--------------|
| 1  | Model          | 0.029 $<0.05$                  | $H_0$ = rejected |
| 2  | Gender         | 0.033 $<0.05$                  | $H_0$ = rejected |
| 3  | Model * gender | 0.933 $>0.05$                 | $H_0$ = accepted |

Based on table 3, the ANOVA test shows that there is a significant effect on both learning models that are indicated by the value of each P-value $= 0.029$ and there is the influence of gender differences indicated by P-value $= 0.033$ with significant $> \alpha 0.05$ which means $H_0$ is rejected. Furthermore, there is no interaction between the learning models and gender differences as indicated by P-value $= 0.933$ with a significance $> \alpha 0.05$ which means $H_0$ is accepted.

The effect size test obtained a value of $d = 0.23$ then these results are interpreted using the table of effect size. It is known that the probing prompting learning model affects the learning outcomes as much as 58%. So, it can be concluded that the probing prompting learning model is quite effective in increasing students’ concept mastery.

Research data shows that the probing prompting learning model provides good concept mastery for male and female students. The average score obtained was increased before and after applying the probing prompting learning model.

This means that the average score of the class that implemented the probing prompting learning model is better than the class that implemented the discovery learning model. This is because the probing prompting learning model enables the students to obtain concept mastery through questions.

The researchers describe the steps of learning in the following figure.
The probing prompting learning model consists of 7 stages by, first, the teacher exposing new situations to the students, for example by paying attention to pictures, formulas, or other situations that contain problems regarding the motion of living things and the motion of objects.

In this stage, the researcher guided the students to solve the problems given regarding motion in living things. Next, the students were allowed to formulate answers.

Next, problems were given to the students related to the objectives and learning indicators. Examples of problems used by researchers can be seen in the following figure.

Through the questions, the students will get used to solving problems. This is similar to Swasono's research which states that through a question, students will not feel bored and will be accustomed to solving questions [24].
In the next stage, the students conduct small discussions with their friends to solve problems and conduct problem-solving discussions if there are differences in answers. Before solving the problems, the students should have a small discussion with their friends. If there is an incorrect answer, then the problems will be solved with the discussion partner. The next stage is where the teachers randomly appoint students to answer questions and then provide responses regarding the questions given. If the answer is correct, the teacher asks responses from other students about the answer to ensuring that all students are involved in the ongoing activity. If the students cannot provide answers, the teacher asks another question whose answer is an indication of the completion of the answer. Then the teacher gives harder questions to fit the basic competency or indicators. The questions are given to different students. Through random assignment, the students will actively participate in the learning process. In accordance with research, students cannot avoid the learning process because, at any time, they can be involved in the question and answer process. Through these stages, students’ concept of understanding can be achieved. According to the average score obtained, the students’ concept understanding achieves an appropriate result [29]. However, the difference of this research lays in the dependent variable which is concept mastery.

At the last stage, the teacher gives a final question about the motion of living things to emphasize the indicators. At the end of the meeting, the students are given a test regarding the motion of living things and objects. One form of the given question can be seen in Figure 5.

1. The direction of the plant's movements caused by the source of the stimuli is called…..
   a. Nasti
   b. Taksis
   c. Tropisme
   d. Endonom
   Reason : …………………………….
   …………………………………..

Figure 6. Examples of Posttest Questions

The first hypothesis tested the effect of learning models on mastery of concept. The result of the ANOVA test shows a significant influence on both learning models which is indicated by the P-value = 0.029 with significant > 0.05 which means H0 is rejected. This means that there is an influence of the probing prompting model on concept mastery. These results are in line with several previous studies which state that the probing prompting model significantly influences the concept mastery [19, 20].

The second hypothesis tested the effect of gender differences. Gender is a characteristic to distinguish the learning potential between males and females. Based on the analysis of research data, there is a significant difference between males and females. ANOVA test showed a significant P-value = 0.033 where 0.033 <0.05 which means that H0 is rejected and H1 is accepted.

The results of the posttest, both the experimental class and the control class, showed that male students scored higher than female students. This means that there are differences in concept mastery between male and female students. This is in line with research conducted by several researchers which findings show that female’s science interest tends to be lower compared to males. This makes a difference in the learning outcomes between male and female students [32].
The third hypothesis tested the interaction between learning models and genders on concept mastery. The learning model used was the probing prompting learning model. The gender in this study is grouped into two categories, male and female. Based on the results of the two-way ANOVA of inequivalent cells, it was obtained that the result of $H_{0AB}$ is accepted. This means that there is no interaction between learning models and gender. This means that learning models do not affect the concept mastery of male and female students. Male and female students who were given the probing prompting learning model and discovery learning model relatively obtained good scores. So, it can be concluded that male and female students can participate well in learning using both learning models [33].

4. Conclusion
The research findings indicate that there is an influence of probing prompting learning model on the concept mastery in science lessons. There are differences in the science concept mastery between male and female students (gender influential). There is no interaction between learning models and students' gender differences on the concepts mastery.

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