Preservice Physics Teachers' Challenges in Laboratory Practice

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Abstract. This study focuses on investigating the challenges encountered by preservice physics teachers (PPTs) in using two different methods for the same investigation using a structured inquiry activity. Eight PPTs will be working in pairs to investigate the image formation in plane mirror activity. Data sources include answers to pre-quiz, laboratory reports, video recordings of laboratory practice, and group interviews with students after the experiment. Based on the analysis of the data, we will discuss challenges that PPTs encounter when they investigate the topic using different experimental methods. Also, suggestions and implications will be presented.

Introduction

Science is based on observation and experimental data to understand natural events in the universe. Science educators, acknowledging the importance of the empirical nature of science and also of active engagement of students in meaningful learning encourage teaching/learning of science through carefully planned hands-on activities. Hands-on science activities that allow for meaningful learning are generally provided by inquiry-based methods, which is essential to science education [1]. Inquiry-based learning as an approach in science education focuses on both developing science process skills and gaining a deeper understanding because learners actively experience the phenomena [2].

Acquisition of physics knowledge should take place through inquiry-based experiments, aligning with the overarching goal of science education [3]. Based on the constructivist theory, inquiry-based learning requires learners to actively question about natural phenomena. Research studies show that laboratory practices significantly enhance cognitive, affective, and skill development [4,5]. Similarly, inquiry-based method improves scientific process skills and conceptual learning [6].

Physics teaching traditionally relies on rote memorization and mathematical formulas, but understanding the nature through physics requires questioning, observation, and experimentation. The discrepancy between how physics is taught and how it is practiced causes students' failure and more importantly, leads to disinterest in physics. Laboratory practices, an important part of ideal physics learning, provide learning environments where students can question and explore natural phenomena. Note that laboratory practices are important for students, especially pre-service teachers (PPTs), as they have the potential to impact their future students. Although laboratory practices help PPTs develop both conceptual understanding and scientific process skills, they can face challenges in the process of developing these understandings and skills. These challenges that PPTs face during inquiry-based laboratory practices can be attributed to different sources such as, as our previous experience shows, the subject being studied, and the method(s) and procedures applied during the experiment [4]. These challenges may also affect learners' conceptual understanding and science process skills.

In the light of the above discussion, it is reasonable to expect that inquiry-based laboratory practices will lead to both conceptual learning and skill development. However, PPTs may face challenges while conducting experiments. In this study, we aimed to investigate PPTs' challenges while they carry out an experiment on image formation in plane mirrors using two parallax and ray tracing methods. The research questions for this study are formulated as follows:

RQ1: What are the challenges faced by PPTs in utilizing different experimental methods in an inquiry-based laboratory activity about image formation in plane mirrors?

RQ2: How do these challenges impact their conceptual understanding and science process skills?

RQ3: What are the perceptions of PPTs regarding the influence of utilizing different experimental methods in an inquiry- based laboratory activity about image formation in plane mirrors on their conceptual understanding and scientific process skills?

Method

Researchers developed a laboratory activity for PPTs to explore image formation in plane mirrors using structured inquiry [1]. Parallax and ray tracing methods were used to clarify image characteristics.

This study is conducted with eight PPTs who are seniors enrolled in a must course designed particularly for physics teachers. Participants took quizzes before the experiment on image formation in plane mirror. The experiment was done in pairs and used two different methods to investigate image formation. The manual included information on the experiment, procedures for each method, and questions to be answered. Having completed the experiment, participants wrote a report which basically included the purpose and conclusion of the experiment, by comparing results from both methods with the theoretical knowledge.

Groups are being video recorded and interviewed as the main data source for research questions. PPTs write laboratory reports and take pre-quizzes, which are also used as data sources for analysis. Data are analyzed qualitatively based on the PPTs' conceptual understanding and science process skills.

Conclusion

Based on the analyses of the data, we will talk about the challenges that PPTs face during the implementation of inquiry-based laboratory activity in terms of conceptual understanding and science process skills. The challenges faced by PPTs cover the theory-practice gap, which refers to a discrepancy between practical knowledge and theoretical knowledge, as well as difficulty in the implementation phase related to science process skills. PPTs have challenges in performing science process skills during the implementation and enhancing their conceptual understanding at the end of the implementation. PPTs' perceptions varied in terms of engagement and interest, ease of understanding, and confidence in learning depending on different experimental methods. Suggestions and implications will be presented.

References

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