Pre-Service Physics Teachers' Perception of Mathematical Modelling and Their Use in Interdisciplinary Physics Teaching

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Abstract. Understanding and effectively applying mathematical concepts are critical components of physics education, yet students often encounter challenges in integrating mathematical principles. This study investigates the mathematical perception and utilization of 12 senior physics education teacher candidates during laboratory sessions. Through surveys administered during lab sessions, participants' background knowledge, perceptions of laboratory learning, and confidence in mathematical calculations and data interpretation are assessed. Additionally, participants' lab report data, interviews, and observations provide in-depth insights into their experiences. The study employs a mixed-methods approach, combining quantitative analysis utilizing descriptive statistics with qualitative exploration via thematic analysis of interview transcripts and observation notes.

Introduction

In the field of science education, understanding and applying basic concepts in physics is often challenging for students and leads to various learning difficulties. It is no longer enough for students to just learn the basics; They also need to develop skills such as critical thinking, problem-solving, and interdisciplinary collaboration. This shows that prospective teachers' understanding of mathematical modeling skills and the integration of these skills into physics teaching practice is of vital importance for the development of both teacher training programs and physics teaching practice. Recognizing the role of the teacher is crucial in addressing the challenges of physics education because teachers play a crucial role in facilitating students to successfully understand concepts and conduct laboratory experiments effectively amidst these challenges. The unambiguous communication of experimental results and the comparison of measurements with other measurements, or with theory, are thus important elements that need to be explicitly developed in science laboratory teaching [1]. Due to this important role of the teacher in physics education, educators' understanding of the methods they use to make physics more understandable, and their use accordingly are of great importance. Science course work is assessed by the teachers themselves rather than by external examiners. This makes the role of the teacher challenging [2]. On the other hand, the procedural understanding of science students is rarely studied, nor used as a starting point for teaching: experimental procedures in science lessons are usually taught as a list of instructions on how to collect a "good" set of measurements and how to manipulate the data [3]. These challenges include misunderstandings in laboratory classes and in interpreting data graphs and tables; these can hinder the acquisition of basic skills in scientific research, and this creates difficulties for teachers both in teaching the theory of the topic and in performing laboratory experiments. Understanding the nature of these obstacles is critical for educators to develop effective strategies to address them and enhance students' learning experience.

This paper aims to investigate the learning difficulties encountered the senior physics education students in physics, focusing specifically on mathematics use in laboratory experiments and misconceptions in data interpretation. By examining teacher candidates' laboratory report, experiences and perspectives, insights can be gained into the root causes of these challenges and potential avenues for improvement in physics education.

Methods

12 teacher candidates from physics education programs will participate in the study. Data will be collected through surveys during laboratory sessions and their lab report data. Participants mostly performed school experiments such as free fall, rotational inertia, simple pendulum motion, electromagnetic oscillations in RLC circuit. Surveys will assess participants' background knowledge, perceptions of laboratory learning, and confidence in calculations and data interpretation. Interviews will provide deeper insight into their experiences. Observations will focus on participation and problem-solving approaches. Data will be analyzed quantitatively using descriptive statistics and qualitatively through thematic analysis of interview transcripts and observation notes. Ethical considerations will be adhered to by ensuring informed consent and confidentiality. Limitations may include sample size and self-report biases.

Findings and Conclusion

The analysis revealed significant challenges among senior physics education students in physics education, particularly regarding their ability to make accurate calculations and interpret data graphs and tables during laboratory experiments. Many students encountered difficulties in maintaining accuracy in measurements and grasping the underlying trends shown in graphical representations. These barriers were compounded by factors such as insufficient prior knowledge and limited exposure to effective teaching methodologies.

Furthermore, participants reported being overwhelmed by the complexity of physics concepts and the demands of laboratory courses, which further hindered their learning process. These findings underscore the critical need for targeted interventions and pedagogical improvements to support teacher candidates in developing foundational skills and conceptual understanding in physics.

Overcoming these challenges is crucial to improving the quality of physics education and equipping pre-service teachers with the necessary tools to develop the scientific literacy and research skills of their future students. By implementing strategies such as supported instruction and hands-on learning experiences, educators can reduce these barriers and develop a more engaging and effective learning environment in physics education. Further research is needed to investigate additional factors affecting physics learning and to evaluate the effectiveness of interventions aimed at improving pedagogical practices in this area.

References

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