

Methodological skills of in-service physics teachers after a research-based learning course

Esmeralda CAMPOS

Austrian Educational Competence Centre Physics, University of Vienna, 1090 Vienna, Austria

Abstract. Developing research competences is an increasing demand in higher education, as it aims to strengthen the link between research and teaching. The literature has classified research competences into five main dimensions. This study aims to evaluate the dimension of methodological skills acquired by physics education students in a research-based learning course. The participants were 15 in-service physics teachers doing their master's in physics education at the University of Vienna. The results suggest that the students acquired competences to plan research processes and apply noncomplex research methods. These findings can promote the design of research-based courses for physics education students.

Introduction

Developing research competences is an increasing demand in higher education, as it aims to strengthen the link between research and teaching [1]. Physics educators not only need to develop experimental research skills, but also educational research skills to evaluate educational interventions in the physics classroom. Few studies have investigated physics and science teachers' research skills. A study performed in Indonesia provided evidence that pre-service physics teachers developed their research skills when taking a research-based learning course [2]. Natural science teachers in Chile were trained to develop research skills in a workshop [3]. Mathematics, and science teachers have been found to develop action research skills when trained specifically [4]. In the framework of research-oriented learning, this study has the objective to evaluate physics education students' research competency development after a research-based learning course.

Methods

The study has a cross-sectional descriptive approach. The participants were 15 in-service high school physics teachers doing their master's in physics education at the University of Vienna. The setting was a research-based learning course on using representations in the physics classroom at high school level. The cohort of students reported they did not have a significant research experience prior to the course. The students carried out a collaborative educational research project with the objective of designing and evaluating a learning activity based on using multiple representations. The course activities involved brainstorming, learning about theoretical frameworks, reviewing literature, making research questions, selecting a methodological approach, collecting and analysing data, acknowledging limitations, and communicating their research results. The students presented two partial reports (after which the instructor provided constructive feedback), a final report, and an oral presentation. At the end of the course, the students answered the R-Comp survey, a reliable Likert-scale survey to assess university students' research competences [1]. The data was analysed descriptively. This contribution presents the median for each item in the "Methodological skills" dimension of the R-Comp survey.

Results

The Methodological skills dimension of the R-Comp survey is further divided into two sections [1]. The median obtained in this study for each statement of the two sections is presented in Table

1. The first section refers to the systematic planning and preparation of the research process. The results provide positive evidence that students acquired skills for planning and preparing the research process. Overall, students didn't find it difficult to formulate research questions or hypotheses, nor to operationalize each step of the research process. They were able to decide on the sources and materials to address their research questions and to plan their research process. The second section refers to the selection and application of methods. The results suggest that students acquired some of the skills to select and apply methods, but still need to train their ability to decide which methods to use for examining a research topic and using complex methods to analyse data. These skills are expected to be improved in the participants' further research experience, for instance when developing their master's thesis.

Table 1. Statements and median values for the methodological skills dimension of the R-Comp survey [1]

Statement	Med
<i>Systematic planning and preparation of the research process</i>	
I find it difficult to formulate specific research questions / hypotheses. *	2
I find it difficult to operationalize each step of the research process. *	2
I am able to decide, which data / sources / materials I need to address my research question.	4
I am able to plan a research process.	4
<i>Selection and application of methods</i>	
I find it easy to decide, which methods I need to use to examine a specific research topic.	3
I am good at judging which method is inappropriate to answer a specific research question.	4
I can apply different research methods appropriate to my research question.	4
I can confidently apply even complex methods to analyse data / sources / materials.	2

*In these statements, a lower median reflects a positive outcome.

Conclusion

The objective of this study was to evaluate the development of research methodological skills of 15 physics education students after a research-based learning course. The results provide evidence that most students acquired competency to plan research processes and apply research methods. The students presented less confidence when asked about applying complex methods to perform analyses. The course provided physics education students with an opportunity to develop methodological skills in a learning environment. Future versions of this course will include explicit instruction of complex methods for analysing data. It is expected that the participants will further train and develop research skills during their master's thesis. These findings can promote the design of research-based learning courses aimed for physics education students.

References

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