Pre-Service Physics Teachers' Challenges in Designing Physics Experiments and While Guiding Their Peers Carry Out These Experiments

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Abstract. Training pre-service teachers on laboratory work is important in Turkey since it is generally not a common practice in Turkish public schools. This study focuses on the laboratory course designed for pre-service physics teachers (PPTs) which aims to equip them with the pedagogical aspects of carrying out laboratory experiments. As part of the course, PPTs design an experiment and guide a classmate while carrying out the experiment. The aim of this study is to investigate a) difficulties PPTs encountered during the design of experiments and in guiding their classmates, and b) contributions of the process on their knowledge and skills.

Laboratory work is considered central for teaching and learning of science by many science educators (see for example, [1], [2], [3]). Findings of many research studies revealed that students benefit a great deal both cognitively and affectively as a result of engaging in laboratory work. In this regard, it is a logical necessity to expect laboratory work to be an essential component of teaching and learning of science. For this reason, many countries explicitly stated in their science curricula that students should engage in laboratory work. Similarly, the national physics curriculum (NPC) of Turkey requires high school students to carry out experiments in order to generate explanations for physical phenomena [4]. However, it is generally not a common practice in Turkish public schools to do practical work since it is widely considered to have no significant contribution in students' performance in the nationwide university entrance examination.

Because of the important role of laboratory work, teachers are expected to be competent in using laboratory work in their instruction. Training teachers is important in Turkey because of the above mentioned problem. Furthermore, because of the nature of laboratory work at universities, particularly at the introductory level, it is thought that preservice teachers do need further instruction on laboratory work at school science level. The laboratory activities at the university level do not generally match quite well with the standards envisioned by the science education community. As several researchers pointed out, laboratory activities are "cookbook style", which rarely give students the opportunity or freedom to think about a problem. Students, as Pushkin [5] argues, are dictated by lab manuals about "what to think, how to think, and when to think" (p. 240).

In our institution, we have included a compulsory laboratory course specifically designed to familiarize pre-service physics teachers (PPTs) with the experiments that can be carried out at high school level matching the NPC and the laboratory equipment available in most public schools. The researchers of this study are the instructor and the teaching assistant of this laboratory course. One of the main purposes of the course is to equip prospective physics teachers with the pedagogical aspects of carrying out laboratory experiments. As part of the course requirements, PPTs are assigned a task to design an experiment related to the instructional objectives in the NPC. Also as part of this task, PPTs are asked to guide and help a classmate while carrying out the experiment they designed and also evaluate experiment report prepared by the classmate. The purpose of this part of the task was to investigate how well preservice teachers guide their students during an experiment and how they assess

experiment reports. Experiment Design Task is assigned to the PPTs at the beginning of the semester (consists of 14 or 15 weeks) and the time schedule shown in Table 1 is applied during each semester related to this task.

Table 1. Time schedule for the Experiment Design Task

Week 5	Determination of topic/objectives
Week 7	Submission of first draft of laboratory manuals
Week 11	Submission of laboratory manuals and teacher copy of the manuals
Week 13	Application session
Week 14	Submission of laboratory report evaluations and reflections

After submitting the first draft of laboratory manual (Week 7), PPTs get feedback from the course instructor and improve the manual considering given feedback. Before submitting the final version of laboratory manual (Week 11), PPTs are expected to conduct the experiment they designed using the manual they prepared at the laboratory by themselves. In that way, they are able to experience the problems that their students may face during conducting the experiment and modify the laboratory manual if necessary. PPTs also prepare a teacher copy of the laboratory manual which involves the necessary data, graphs and answers to the questions. In the application session (Week 13), PPTs guide and help a classmate while he/she is carrying out the experiment they designed. After the application session, their classmates submit a lab report to them. At the last week of the semester, PPTs evaluate the reports, submit laboratory report evaluations and their reflections.

Data sources of this study consists of the experiment manuals designed by the students, video recordings of the experiments' application process, evaluations of experiment reports, and pre-service teachers' written reflections on the process of designing and guiding his/her classmate. Data were collected during three consecutive semesters from a total of 34 preservice physics teachers. Data analysis process is still ongoing. After data analysis process, a) difficulties pre-service teachers encountered during the design of experiment and in guiding their classmates, and b) contributions the process has made to their knowledge and skills as reported by the participating teachers will be reported.

Keywords:
Pre-service teachers, laboratory experiments

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