A Study Evaluating the Knowledge of Science Teacher Candidates Regarding Microscopes

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Abstract

This study was conducted with 91 second-year students, or teacher candidates, attending the science education program of an education faculty in a Turkish university. In this study, students were asked to complete an open-ended and gap-filling question, and their answers were evaluated according to a five-point Likert-type rubric. In addition, we also analyzed the frequency of the codes associated with the correct answers. In this context, the aim of this study was to determine science teacher candidates' level of knowledge regarding microscopes. Based on the study results, we determined that the science teacher candidates generally had a partially adequate knowledge on the use of microscopes, and that they especially had difficulties in determining and naming the different types of microscopes, and in identifying the condenser and diaphragm components.

Keywords: Knowledge on microscopes, science education, teacher candidates

Introduction

Science education is field involving the use of wide range of visual materials and technological tools. These materials and tools allow students to work and perform experiments like scientists, to structure scientific knowledge, and to thereby become familiar with scientific practices and applications (Jewitt, Kress, Ogborn and Tsatsarelis, 2001). Laboratory studies, in particular, can be viewed as the "science kitchen" of science education. This "science kitchen" comprises a large variety of materials. One of the main laboratory materials used in science education is the microscope – an instrument that enables its users to see entities and concepts (stoma, cell, tissues, etc.) that cannot be observed with the unaided eye (Dökme, Doğan and Yılmaz, 2010; Green and Smith III, 2005; Sinsel, 2010; Dikmenli, Türkmen and Çardak, 2002; Demirbaş and Pektaş, 2010).

The microscope is defined as "an optical tool consisting of a lens system that enables the visualization and evaluation of both living and non-living entities too small to be seen with the naked eye" (Özata and Türe, 1999; Dökme, Doğan and Yılmaz, 2010; MEB, 2011). Being knowledgeable about the structure and characteristics of microscopes, and being able to identify the problems encountered during the use of microscopes, is important for allowing instructors to better teach the proper use of these tools (Uzel, Dikmen, Yılmaz and Gül, 2011). A study performed by Yeşilyurt (2004) determined that the incorrect and insufficient knowledge of teacher candidates about microscopes was mainly due to the limited amount of practice and classes they have on this tool. Zeren Özer, Güngör and Şimşekli (2011) similarly demonstrated in their study that teacher candidates often experience problems in experiments requiring the use of microscopes.

To ensure that students can effectively learn about laboratory tools and equipment, teachers must first have adequate knowledgeable about these tools and equipment, and also be able to transfer this knowledge to their students (Harman, 2012).The study of Benzer and Demir (2014) investigated the level of knowledge of teacher candidates from all classes/years regarding the use of microscopes, and emphasized the importance their knowledge of microscopes.

According to the views of teachers, the most frequently used educational tool in their classes is the "textbook," while the least commonly used tool is the "microscope" (Öztekin and Er, 2014).In their study, Taşdelen and Güven (2012) describe that greater emphasis should be placed on experimental applications in the programs of teacher candidates; that laboratories should be adequately outfitted in accordance with present-day scientific and technological requirements; that teacher candidates should practice the use of microscopes by making observations; and that sufficient importance should be accorded to communication technologies.

For all of these reasons, ensuring that science teacher candidates – the science teachers of the future – have adequate knowledge on the use of microscopes is important for teaching them the proper use of this technology as well as other laboratory tools and equipment. In this context, the aim of this study was to determine the technical knowledge of science teacher candidates regarding microscopes.

Method

This study aiming to determine and describe the level of knowledge of science teacher candidates, attending a science education department, regarding the use of microscopes was performed by using a screening model. Studies based on the screening model involve the description and evaluation of the subjects and events relating to a particular topic/area of study (Sönmez and Alacapınar, 2011).The study was performed with 91 second-year science teacher candidates attending a university in Turkey. The teacher candidates were asked an open-ended and gap-filling question. This single question showed the picture of a "monocular light microscope," and asked the teacher candidates to first write down the name of the microscope, and then the name of every individual microscope component on this picture in the respective blank areas. The validity of this open-ended question was evaluated and confirmed by two researchers, and the teacher candidates' answers were evaluated according to a 5-point Likert-type rubric. We also analyzed the frequency of the codes associated with the correct answers written in the blank areas.

Results

The study results are shown in Table 1 and Table 2. Table 1 shows the science teacher candidates' level of knowledge regarding microscopes, as determined based on the data obtained from their responses and the five-point rubric; while Table 2 shows the frequency of certain codes regarding microscopes in the students' answers.

Table 1: The Science Teacher Candidates' Level of Knowledge Regarding Microscopes

Very Adequate	Adequate	Partially Adequate	Inadequate	Very Inadequate
0	13	60	17	1

As shown in the table above, the science teacher candidates generally had a partially adequate level of knowledge regarding microscopes.

Table 2: Certain Examples of the Answers Provided by the Teacher Candidates Regarding the Components of Microscopes

Codes	N
Writing the name of the microscope	0
Identifying the condenser	31
Identifying the diaphragm	17
Identifying the Fine Adjustment/Focus	87
Identifying the Ocular Lens	78
Identifying the Objective Lens	67

Table 2 shows the frequency with which the teacher candidates were able to correctly identify certain components of microscopes. As shown in this table, none of the teacher candidates were able correctly or fully write the name of the microscope, while only a few teachers were able to identify the condenser and diaphragm. They were, however, better able to identify the objective lens, ocular lens and fine adjustment/focus.

Conclusion and Discussion

Students learn about materials and objects such as plants, batteries, light bulbs and microscopes by using and/or building them (Sivertsen, 1993). Flick and Bell (2000) emphasized in their study the importance of the microscope as a tool that allows teachers to better teach science and technology. Microscopes are one of the most important tools and equipment used in laboratories. Benzer and Demir (2014) similarly described that the use of microscopes is important both for teachers and their students. In their study; Ural Keleş, Er Nas and Çepni(2009) determined that teacher candidates have various misconceptions about the functioning of microscopes, and the way in which they form images. Uzel et al.(2011) observed that while most science teacher candidates were able to identify the ocular lens, the stage, the fine adjustment and the coarse adjustment components of microscopes, they were generally unable to identify the condenser and the condenser adjustment.

The results of our study indicated that science teacher candidates generally had a partially adequate level of knowledge about microscopes, and that they had difficulties especially in identifying the name of the microscope and the condenser and diaphragm components. The studies of Uzel et al. (2011) and Harman (2012) similarly determined that many teacher candidates had incomplete and incorrect knowledge about the use of microscopes. Ketelhut, Nelson, Clarke and Dede (2010) described that even virtual microscopes can give students/teacher candidates the impression of actually performing an experiment, and of testing hypotheses and carrying out tests in a manner similar to scientists. In fact, Taşdelen and Güven (2012) determined in their study that teacher candidates wished to see a greater emphasis on experimental applications in their courses, and to perform observations by using microscopes. In this context, we believe that it is important for science teacher candidates – the teachers of the future – to have adequate knowledge on microscopes, and that it is necessary to conduct further studies assessing their level of knowledge about this instrument.

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