

The Impact of Experiences on Preservice Science Teachers' Self-Efficacy in Teaching Science Concepts in the Context of Socioscientific Issues

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Introduction

This study is designed to investigate the impact of experiences on preservice science teachers' (PSTs') self-efficacy of teaching science concepts in the context of socioscientific issues (SSI). If PSTs have constructive experiences in socioscientific issues, they will have a higher self-efficacy in teaching science concepts in the context of socioscientific issues.

Zeidler and Sadler (2004) defined socioscientific issues as “societal dilemmas with conceptual, procedural, or technological links to science” (p. 5). Within these, in its inherent structure, while considering moral principles, emotions, and acting virtuous, SSI aims students to think about how decisions are made regarding the society they live in and promote scientific literacy (Zeidler et al., 2005). In real-life scenarios where students can express their moral beliefs in the context of SSI, they also act and think like scientists by skeptically approaching the topics (Zeidler & Khan, 2014). The 21st century brought and with the SSI education, the importance of scientific literacy has been noticed, including “informed decision making; the ability to analyze, synthesize, and evaluate information; dealing sensibly with moral reasoning and ethical issues; and understanding connections inherent among socioscientific issues” (Zeidler et al., 2005, p. 358). Therefore, SSI intentionally uses ill-structured topics to create an argumentation environment for students to develop their moral reasoning and “functional scientific literacy” (Zeidler & Nichols, 2009). Nowadays, SSI is highly integrated with the science curriculums worldwide and in Turkey. The main objectives of the science curriculum emphasize developing reasoning ability, scientific thinking habits, and decision-making skills using socioscientific issues (Ministry of Education, 2018).

Guskey and Passaro (1994, p. 628) defined teacher self-efficacy as “teachers' belief or conviction that they can influence how well students learn, even those who may be considered difficult or unmotivated.” According to Ilhan et al. (2015), teachers' self-efficacy beliefs take shape during their preservice experiences and internships. It has been argued that teachers with high efficacy beliefs are more likely to use new instructional strategies and student-centered approaches (Ross & Bruce, 2007). Similarly, teachers' self-efficacy beliefs are important for the successful implementation of SSI-based science teaching due to its complex nature (Kilinc et al.,

2013; Lee et al., 2006). In this study, the researcher tested the hypothesis that if preservice science teachers in the senior year have positive experiences regarding teaching science concepts in the context of socioscientific issues, they will have higher self-efficacy in teaching it. In a similar vein, negative experiences will lead PSTs to have low efficacy perceptions about themselves (Kinskey & Callahan, 2021). Bandura (1977a) argued that there are four sources of self-efficacy beliefs. First, performance accomplishments are related to the mastery of experiences (Bandura, 1977a), which means unpleasant experiences can cause lower self-efficacy, whereas successful ones promote a higher self-efficacy perception. Second, vicarious experience refers to observing others doing a task that influences one's self-efficacy expectations. Third, verbal persuasion means that positive statements and feedback can increase one's belief in themselves and self-efficacy (Bandura, 1977a). Lastly, Bandura (1977b) summarizes psychological states as "another constituent source of information that can affect perceived self-efficacy in coping with threatening situations" (p. 198), which means one's emotional arousal in an experience affects how they judge themselves. In the context of this study, performance accomplishments are gained through microteaching or internship lessons in the context of SSI (Kinskey & Callahan, 2021). Vicarious experiences are gained by observing other students' SSI teaching (Kinskey & Callahan, 2021). Verbal persuasions are gained through obtaining feedback after mastery or vicarious experiences. Lastly, physiological states, or emotional arousal, influence PSTs' self-efficacy via negative or positive feelings experienced through their and peers' micro-teachings (Öztürk, 2016).

Methodology

In this research, a mixed-method design was used. First quantitative then qualitative data were collected to supplement quantitative findings. Through quantitative data, senior preservice science teachers' (PSTs') self-efficacy beliefs in teaching science concepts in the context of socioscientific issues were obtained. Qualitative data focused on PSTs' experiences on the four sources of self-efficacy (vicarious experiences, performance accomplishments, verbal persuasion, and emotional arousal). Both data sources were used to examine the relationship between the PSTs' experiences and self-efficacy beliefs in teaching science concepts in the context of SSI.

In the quantitative part, 38 senior PSTs pursuing their education in the department of science education in a public university located in the Central Anatolia region in Turkey participated to study voluntarily. Female participants (94.7%) made up the majority of the sample. For the qualitative part of these participants, eight of them were interviewed (one of them was male, and

seven were female). These PSTs were purposefully chosen because they took an SSI-based teaching course in their fourth year of the teacher education program. All participants voluntarily participated in the interviews.

Two data collection instruments were used. SSI-related self-efficacy beliefs scale was used to collect quantitative data. This instrument was developed by Öztürk (2016). Öztürk (2016) mainly considered the STEBI (Science Teaching Efficacy Belief Instrument, Enochs & Riggs, 1990) scale in constructing the instrument. The instrument was prepared in Turkish, the mother tongue of PSTs. It included 34 items in the form of a 5-point Likert scale ranging from “1 = strongly disagree” to “5 = strongly agree.” The instrument had three subdimensions, namely: fostering argumentation and decision-making on SSI, general instructional strategies of SSI teaching, SSI teaching outcome expectancy. Cronbach alpha reliability values were found as .89, .74, and .72, respectively.

Semi-structured Preservice Science Teacher Interview Protocol was used to collect interview data. The interview protocol was prepared by the researchers. The protocol included items to reveal the experiences that PSTs have in four fundamental sources of self-efficacy and PSTs SSI teaching experiences gained through courses taken during teacher education programs. As Ilhan et al. (2015) stated, teachers' self-efficacy beliefs are formed primarily during their internship period. Therefore, senior PSTs were assumed to distinguish the importance of experience in SSI-based teaching and deliver deeper data in self-efficacy in SSI-based teaching.

Quantitative data were analyzed by using the SPSS program, and qualitative data were analyzed by using the constant-comparison data analysis technique.

Conclusion

The scores obtained through the SSI-related self-efficacy beliefs scale were analyzed according to subdimensions. The PSTs scored 3.93 out of 5.00 for the total score of the scale. However, there are some variations among the sub-dimensions. The PSTs had the highest score in the dimension of fostering argumentation and decision-making in SSI ($M = 4.20$). The mean score for the SSI teaching outcome expectancy dimension was 4.01. They received the lowest score on general instructional strategies of SSI teaching ($M = 3.55$). These results revealed that the PSTs had better self-efficacy beliefs regarding their pedagogical skills in having effective argumentation in the classroom and improving students' decision-making skills. However, they were not efficacious in terms of managing the classroom discussion environment, teaching time during the discussion,

and dialogical discourse.

Qualitative data revealed that PSTs frequently emphasized the importance of experiences for effective SSI teaching. Even though they valued the micro-teaching experiences, they thought more experiences were needed to develop their pedagogical skills for the dynamic nature of the argumentation environment. Influential mastery experience sources from the highest frequencies to lowest frequencies were their experiences in mentoring schools, at university courses, observing peers (vicarious experiences), teachers, and professors. The PSTs were also considered that feedback received from instructors, assistants, and peers for their micro-teaching was also effective in having better self-efficacy beliefs. The majority of the PSTs found micro-teaching experiences beneficial in overcoming stressful aspects of the preparation part, such as effective use of time and integrating multiple perspectives to the argumentation process. One of the main conclusions reached by this study was, as Bandura (1977a) stated, mastery experiences were the most influential source of self-efficacy in SSI-based teaching practices.

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