

Sources of Preservice Early Childhood Teachers' Self-Efficacy Beliefs About Teaching Science: A Phenomenological Study*

Okul Öncesi Öğretmen Adaylarının Fen Öğretimi Öz Yeterlik İnançlarının Kaynakları: Bir Fenomenoloji Çalışması

Ahmet Simsar**

Shannon G. Davidson***

To cite this article/ Atf için:

Simsar, A., & Davidson, S. G. (2020). Sources of preservice early childhood teachers' self-efficacy beliefs about teaching science: A phenomenological study. *Eğitimde Nitel Araştırmalar Dergisi – Journal of Qualitative Research in Education*, 8(3), 776-795. doi: 10.14689/issn.2148-2624.1.8c.3s.1m

Abstract. The purpose of this study is to explore preservice early childhood teacher's self-efficacy beliefs on teaching science and to understand the sources of their self-efficacy beliefs. Three preservice teachers who were enrolled in an early childhood science methods course participated in this study. Through analysis of semi-structured interviews and observational field notes, the results suggest that participants' experiences with curriculum and standards held a negative effect on their self-efficacy beliefs. Additionally, the participants' mentor teachers, prior K-16 science teachers, and the college professor who taught the Science Method Course all had several positive impacts on their self-efficacy beliefs. Participants' science experiences both as K-12 students and in their supervised teaching held both positive and negative effects on their beliefs about teaching science. The results of this study may support teacher educators and researchers in considering carefully the influencing sources of preservice teachers' self-efficacy beliefs for science teaching.

Keywords: Early childhood education, preservice teachers, science teaching, self-efficacy.

Öz. Bu çalışmanın amacı okul öncesi öğretmen adaylarının fen öğretimi öz yeterlik inancını ve onların öz yeterlik inancının kaynaklarını anlamayı açıklamaktır. Okul öncesinde fen eğitimi dersini alan üç (3) öğretmen adayı bu çalışmaya katılmıştır. Yarı yapılandırılmış görüşme ve sınıf içerisinde derse katılımla ilgili gözlem notlarının analizlerine bakıldığında, katılımcıların fen eğitimi ders planlamaları ve kazanımlarıyla ilgili olumsuz deneyimlerinin kendilerinin öz yeterlik inançlarına olumsuz etki ettiği bulunmuştur. Ayrıca katılımcıların uygulama öğretmenleri (mentor öğretmen), daha önceki okul öncesinden üniversiteye kadar fen eğitimi veren öğretmenleri ve okul öncesinde Fen eğitimi dersini veren profesörün bazı olumlu yönde fen öğretimi öz yeterlik inançlarına katkı sağladığı bulunmuştur. Ayrıca araştırmaya katılan öğretmen adaylarının öğretmenlik uygulamaları boyunca yapmış oldukları fen etkinlikleri ve okul öncesinden lise son sınıfa kadar olan fen eğitimi deneyimleri yine bazı olumlu ve olumsuz etkilerini olduğu belirlenmiştir. Çalışmanın bulguları doğrultusunda öğretmen yetiştirme programlarına ve araştırmacılara, öğretmen adaylarının okul öncesinde fen eğitimi öz yeterlik inançlarının kaynakları ve bunların etkileri üzerine çalışmalar yapılabileceğini önermiştir.

Anahtar Kelimeler: Okul öncesi eğitimi, öğretmen adayları, fen öğretimi, öz-yeterlik

Article Info

Received: 06.05.2019

Revised: 15.06.2020

Accepted: 20.06.2020

* Some part of this study was presented at NAEYC's National Institute for Early Childhood Professional Development Conference, Louisiana, 07-10- July, 2015.

** Correspondence: Kilis 7 Aralık University, Turkey, ahmetsimsar@kilis.edu.tr ORCID: 0000-0002-4335-878

*** Florida State University, School of Teacher Education, Florida, USA, ShannonGDavidson@gmail.com ORCID: 0000-0003-3583-4147

Introduction

In an increasingly globalized world where cultural and informational borders are often blurred, it is essential that all students be prepared to work with the new demands of the twenty-first century (Stein & Smith, 2011; Strandberg & Lindberg, 2012). Researchers have suggested that one way to help students to bridge this gap is through reforms in science education, which can support learning in all students by emphasizing the importance of critical thinking, problem-solving, and developing explanations about the world around them (Duschl, 2008; Schweingreuber, Duschl, & Shouse, 2007). However, many in-service teachers do not often feel well prepared to teach science in innovative or reform-minded ways that further students' ability to understand the world around them in scientific ways (Duschl, 2008). This is particularly true for early childhood teachers who may feel, and in fact be, less adequately prepared to teach science to their students and therefore have less self-efficacy toward science teaching (Baniower et al., 2012; Fulp, 2002).

Science teaching self-efficacy has great potential to positively or negatively impact a teachers' ability to influence students' learning and appreciation for science. In an early study, Ashton and Webb (1986) found that teachers who have high self-efficacy beliefs have been known to use more effective instructional methods during teaching and often encourage students to learn more successfully. Conversely, Soodak, Podell, and Lehman (1998) found that teachers who have low self-efficacy beliefs often demonstrate a lack of collaboration with other teachers and rely on ineffective teaching methods, which negatively impact student learning.

The current study seeks to explore the science teaching self-efficacy beliefs of three preservice early childhood teachers and to understand the influencing factors that have shaped their self-efficacy beliefs. By closely examining the ways in which science teaching self-efficacy may be influenced in early childhood preservice teachers, this study sheds light on the various ways that teacher education preparation programs might take such influencing factors seriously and support future teachers toward holding higher science teaching self-efficacy beliefs.

Literature Review & Conceptual Framework

Teacher efficacy has a significant role on teachers' development and instructional approaches while also having impact on whether teachers can improve students' learning and their professionalism (Rizvi & Elliot, 2005; Tschannen-Moran & Hoy, 2001). Ashton (1984) explained teacher efficacy as specific expectations which can help students' learning, and Denham and Michael (1981) have further defined teacher efficacy as "an intervening variable composed of a cognitive and an effective component" (p.40). Teacher efficacy has also been conceptualized as more specific to a teacher's belief about his or her ability to increase student learning and behavior (Gibson & Dembo, 1984; Putman, 2012; Tschannen-Moran, Hoy, & Hoy, 1998). Due to the purposes of this study, self-efficacy might be considered both the preservice teachers' expectations and intervening variables that come from external sources, as well as the internal and personal beliefs that teachers hold about their ability to teach science.

Teacher self-efficacy beliefs may be influenced by teacher training programs, teaching experiences, system variables, personal variables, and causal attributions (Denham & Michael, 1981). In this sense, system variables can be explained as teachers' career developments such as being a professional educator, the challenges they face in their career, and the support they receive from administration and other teachers. For personal variables, these can be thought of as teachers' self-concept, gender, and ethnic background. For causal attributions, these can be classified as factors which are related with students, parents, school, society and teacher training programs (Denham & Micheal, 1981). As previously noted, it has been found that teachers who hold high self-efficacy beliefs often use more effective teaching methods that support student learning, while those with less self-efficacy have a more difficult time engaging in reform-based instruction and supporting student learning (Ashton & Webb, 1986; Soodak et al., 1998).

Self-efficacy theory, as developed by Bandura (1977a), is described as "people's beliefs about their capabilities to produce designated levels of performance that exercise influence over events that affect their lives" (p.71). With this in mind, people's feelings, thinking, motivation, and behaviors are also influenced by their self-efficacy beliefs (Bandura, 1977a). Two important dimensions of self-efficacy are those of efficacy expectations and outcome expectations (Bandura, 1977a). Efficacy expectations are described as "the conviction that one can successfully execute the behavior required to produce the outcomes" (Bandura, 1977b, p.79). Efficacy expectations play a main role on people's choice of activities and how much they will spend effort during times that require dealing with stressful situations (Bandura, 1977a). Outcome expectancy is defined as "a person's estimate that a given behavior will lead to certain outcomes" (Bandura, 1977b, p.79). These two dimensions have strong influence on one's behavior. Figure 1, which was developed by Bandura in 1977a, shows the relationship between these two dimensions and their influence on behavior and outcome.

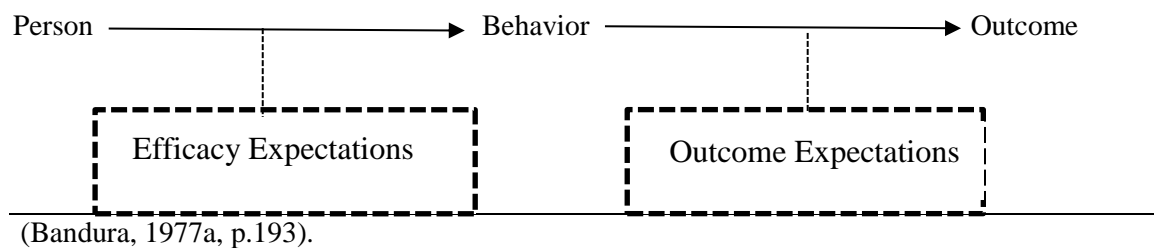


Figure 1. Diagrammatic presentation of the difference between efficacy expectations and outcome expectations.

According to Bandura's model (Figure 1), an individual's behavior is affected by their beliefs about efficacy expectations in relation to a specific topic. This behavior then moderates the individual's outcome expectations or their belief that their behavior can influence the outcome which in turn is thought to impact the outcome. For instance, a child who believes they can successfully learn how to ride a bicycle (efficacy expectation) without training wheels may be more inclined to practice their riding on a daily basis (behavior). As the child continues to practice this behavior with training wheels, their belief in their own capabilities to ride a bicycle may then grow into a confidence that supports that, should they take the training wheels off, they will be able to balance and ride (outcome expectations). The expected outcome then becomes reality when the child is successfully able to stay upright once the training wheels come off the bicycle.

From this example it is not a far stretch to relate this process to how teachers view their teaching (Tschannen-Moran et. al, 1998). Teachers hold self-efficacy beliefs about their own abilities to teach particular subjects, such as science, and these beliefs shape instructional behaviors, which in turn shape the outcome expectancies and outcomes for students. One way of understanding how teachers come to hold these beliefs is by examining four factors which influence self-efficacy: mastery experiences, vicarious experiences, social (verbal) persuasion, and psychological or emotional conditions (Bandura, 1977a; Stajkovic & Luthans, 1998).

Mastery experiences referred to an individual's earlier performances in activities and tasks. People can create strong self-efficacy beliefs through mastery experiences depend on the timing and total pattern of experiences (Bandura, 1977b). Stajkovic and Luthans (1998) describe two factors that are related with mastery experiences: environmental factors and perceptions of ability. Environmental factors refer to one's independence of in a particular task, available resources, physical distractions, physiologically or psychologically dangerous situations, external help by others, and the type of supervision that one receives during mastery experiences. Perceptions of ability include how one views their capability with acquirable skills (Stajkovic & Luthans, 1998), such as learning how to perform certain necessary tasks and understanding the discourse within a mastery experience context. These two factors are related with mastery experiences due to their different impacts of someone's mastery experiences in related contents. Researchers stated that it doesn't mean self-efficacy occur direct results of performance results. It is results of the how the person performs by the impacts from environmental factors. For instance, by the giving limited resources and guidance, person may produce large self-efficacy by the using his/her creativity to solve or use materials for problem (Stajkovic & Luthans, 1998).

Vicarious experiences refer to those experiences that are not firsthand, but instead are observed as someone else performs and succeeds in a task that the observer may have to perform later. In this way, vicarious experiences are a source of modeling. Stajkovic and Luthans (1998) state that vicarious experiences can be useful for training and professional development programs in order to enhance someone's self-efficacy levels. At this point, Simsar (2016) concluded that mentor teachers modeling had positive relationships with their preservice early childhood teachers' science teaching self-efficacy beliefs. Simsar (2016) also summarized that during vicarious experiences teacher candidates had chance to observe and learn how to do that task by the seeing model.

Social (verbal) persuasion is described as strengthening personal self-efficacy by discussing and understanding the reasons for doing tasks. As individuals relate to others involved in the context of their tasks and find meaningful reasons for why the tasks are important, there is an improved effect on self-efficacy (Stajkovic & Luthans, 1998).

Psychological or emotional conditions are related with a person's judgment of anxiety and vulnerability of stress as related to the task, as well as the positive feelings of accomplishment or success they may have in the task context (Ashton & Webb, 1986; Bandura, 1977a; Ginns, Tullip, Watters, & Lucas, 1995; Kazempour, 2014; Protheroe, 2008; Putman, 2012; Riggs, 1988; Stajkovic & Luthans, 1998). If an individual feel particularly stressed or anxious about a task, they may avoid the work altogether and this would negatively impact self-efficacy beliefs (Putman, 2012; Riggs, 1988; Stajkovic & Luthans, 1998).

In the area of science teaching, researchers suggest that science teaching methods courses taken, prior science experiences, educational level, science classes taken during elementary and high

school education, and attitudes towards science can all be seen as influencing factors on teachers' science teaching self-efficacy (Avery & Meyer, 2012; Bayraktar, 2011; Bulunuz & Jarrett, 2010; Englehart, 2010; Kırık, 2013; McKinnon & Lamberts, 2014; Mulholland, Dorman, & Odgers, 2004; Simsar, 2016; Velthuis, Fisser, & Pieters, 2014; Worch, Li, & Herman, 2012). Science teaching experiences during teaching practicums have been found to have some impacts on preservice teacher' science teaching self-efficacy (Aslan & Sağır, 2008; Cantrell, Young, & Moore, 2003; Cone, 2009; Englehart, 2010; Kiremit, 2006; Kırık, 2013; Plourde, 2002; Woolfolk, 2000). In addition, preservice teachers' self-efficacy beliefs are also influenced during their teaching experiences and teacher training program (Simsar, 2016). It has been found that preservice teachers' self-efficacy often increases during their college education and decreases when they start their job as an in-service teacher (Woolfolk, 2000).

Indeed, the research evidence is clear in that the nature and quality of university teacher preparation programs is an influential factor in terms of preservice teachers' self-efficacy beliefs (Avery & Meyer, 2012; McKinnon & Lamberts, 2014; Velthuis et al., 2014; Worch et al., 2012). Some researchers have discussed impacts of inquiry-based science courses on preservice teachers' self-efficacy for science teaching, understanding of science, and willingness to teach science in their future experiences (Avery & Meyer, 2012; Bursal, 2012; Kırık, 2013; Sackes, Flevares, Gonya, & Trundle, 2012; Simsar & Dogan, 2020; Watters & Ginns, 2000). Avery & Meyer (2012) stated that if preservice teachers have an experience with inquiry-based science education, they often become more comfortable with teaching science. Similarly, Watters and Ginns (2000) describe the importance of science methods courses for increasing preservice teachers' self-efficacy toward science teaching in that such courses can encourage preservice teachers to find value in teaching science and grow in confidence toward their science teaching (Watters & Ginns, 2000).

Kiremit (2006) found that when preservice teachers have higher self-efficacy about teaching in a subject such as science, they are then able to plan, create and teach better lessons than preservice teachers who have lower self-efficacy about teaching science. On the other hand, Woolfolk (2000) stated that "student teachers (preservice teachers) often underestimate the complexity of the teaching tasks and their ability to manage many agendas simultaneously" (p.6). Therefore, it is important for preservice teachers to approach science with a strong understanding of the conceptual and underlying guiding principles of science and high levels of self-efficacy about science teaching.

Relatedly, Simsar (2016) found that K-16 classroom teachers, spending time teaching science in their practicum setting, and observing their mentor teachers' behavior and attitudes about science teaching in early childhood classrooms impacts preservice early childhood teachers' science teaching self-efficacy beliefs. Specifically, when mentor teachers' model how to teach science and give feedback to preservice teacher about their science teaching, these actions can positively influence their science teaching self-efficacy beliefs. Building off of this finding, the current study aims to further explore sources that have built preservice early childhood teachers' science teaching self-efficacy beliefs, using Bandura's (1977a) and Stajkovic & Luthans (1998) conceptualization of the four major influencing factors as guiding principles of self-efficacy about science teaching.

Methodology

Design of the Study

The present research takes a qualitative phenomenological study approach to investigate the influencing factors that shape science teaching self-efficacy for preservice early childhood education teachers (Gall, Borg & Gall, 1996; McMillan, 1996). The basis of the phenomenology approach is formed by individual experiences. In this approach, the researcher deals with the personal experiences of the participants and examines the perceptions of the individual, and the meanings they attribute to phenomena (Büyüköztürk et al., 2017). Phenomenology is a descriptive research design. In this respect, it is more important to define phenomena rather than generalization in such studies (Büyüköztürk et al., 2017; Merriam, 1998). This study took place at a large, four-year research university in the southeastern United States. In order to understand the preservice early childhood teachers' science teaching self-efficacy beliefs, primary data were collected through individual semi-structured interviews that focused on personal knowledge and experiences about science and science teaching in early childhood education. These interviews were conducted during the penultimate semester of the preservice teachers' undergraduate program in early childhood education. Each participant was enrolled in a Science Methods course that included a weekly practicum experience in a K-2 classroom. In addition to the primary data of the interviews, the researchers also conducted observations during the Science Methods course. The number of preservice early childhood teachers who were enrolled in Science Method Course was 24. During the observation, each participant was observed separately, and field notes were taken using observational rubrics.

Participants

Three out of 24 preservice early childhood teachers from Science Method Course preservice early childhood teachers voluntarily participated in the current study. While all three of the participants held high school degrees, one additionally attained an Associate (AA) degree from a community college before her admittance into the teacher education program. One of the three participants went to a high school which had Early Childhood Education programs in her school. Regarding exposure to science teaching in their practicum, two of the participants stated that they had never seen science taught by their mentor teacher when they were in teaching practicum. However, one of the preservice teachers stated that she had "*pretty good science experience*" with her mentor teachers during her teaching practicum. Based on observations, three of the participants used hands on science activities when they were in their teaching practicum. All participants reported taking several science classes during their secondary education such as, physics, biology, chemistry, marine biology, and anatomy. They were also currently enrolled at the time of this study in the Science Teaching in Early Childhood Education methods course as a requirement of their early childhood teacher education program.

Data Collection and Data Analysis

The data collection process in phenomenological research was explained by Sanders (1982) in three basic steps as semi-structured interviews with individuals, taking notes of the relevant experiences of individuals in detail and observing the attitudes of the individuals towards the behaviour under research. Büyüköztürk et al. (2017) emphasized the necessity of carrying out

interviews in the phenomenology studies in order to reveal the experiences related to the phenomenon and their meanings. In this context, it can be said that the most used technique as a data collection tool in phenomenology research is the interview technique. Ersoy (2019) have stated that the interview questions can be in the form of structured or semi-structured. For data collection, semi-structured interviews and observations were used. The interview protocol consisted of sixteen questions, which were asked to participants individually. These were audio-recorded and transcribed by the researchers. Each interview lasted between 20 and 45 minutes. The interview questions were created by the researchers and consisted of three questions about each participant's educational background, three questions related to prior science experiences, three questions related to self-evaluation around science content knowledge, three questions related to attitudes toward science, and four questions related to beliefs about teaching and practicum experiences which preservice teacher has classes about teaching practicum. The interview protocol was developed based on the current literature on the science teaching self-efficacy beliefs and their sources and influences (Bandura, 1977a; Stajkovic & Luthans, 1998). To ensure the reasonableness and validity of the interview protocol, the questions were sent to three experts in the field: an assistant professor in Early Childhood Teacher Education, a professor in Science Teacher Education, and a professor in the Department of Education who has expertise as a qualitative researcher. These colleagues evaluated the interview questions for validity. The questions were then asked to five preservice teachers who did not participate in this study in order to pilot the protocol reliability. Minor revisions were then made to the questions. When interview questions were ready, face-to-face meetings were then scheduled for each of the three participants based on their availability.

In addition, the researchers conducted observations during preservice teachers' Science Methods Course. The aim of the Science Method Course was to provide instruction on teaching science at the early childhood level. For each class meeting, the instructor professor divided the time into two instructional parts: a lecturer-style portion and a hands-on portion. In the first part, the professor led discussions about the aims of science teaching, various science teaching methods, assessment and evaluation, and supporting young children in developing positive attitudes about science. In the second part of the course meetings, the professor would lead hands-on experiments with students about related science content that is developmentally appropriate for young children, such as weather, force and motion, living and nonliving things, electricity, and day and night. In the second portion, both the instructor and the students were expected to be active participants in these activities. Depending on the activities, preservice teachers worked individually or in groups. For the purpose of the study, preservice teachers were observed when they were working as individuals as well as in groups. Each of the observations took 25-30 minutes for each participant. Each participant was observed at a different time. During observations, participants' behaviors, discussions, and spoken ideas about related science activities, and answers to instructor and peer's questions about related science contents were collected.

Moustakas (1994) has indicated that the data analysis process in phenomenology studies is as follows: 1) identifying important expressions, 2) classifying common expressions, 3) thematising the meaning sets, 4) forming structural and tactile representations and 5) combining structural and tactile representations. In this study, the answers of the participants to each question were analysed during the data analysis by paying attention to the phenomenological data analysis process of Moustakas (1994). During data analysis, a qualitative analysis software, NVivo, was used for creating codes and analyzing interviews and observations and emergent

subcoding was employed to add more detail to the data (Miles, Huberman, & Saldana 2014). Based on this coding technique, primary codes were developed from the literature: mastery experiences, physiological and emotional states, vicarious experiences, and social persuasion. After these main codes were established, subcodes were created. For example, the subcodes “for teaching experiences” and “prior science classes” were created under mastery experiences because of the definition of mastery experiences. Due to the data of study, two subcodes which were created based on their positive and negative effects on the preservice teachers’ self-efficacy beliefs were categorized while using evaluation coding technique. Evaluation coding is about judgments about merit or content (Miles et al., 2014).

Results

Mastery Experiences

Mastery experiences are related to one’s previous attitudes, interest and behaviors toward something. If someone has positive attitudes towards something her/his self-efficacy about related that may be higher than who has negative attitudes. It is also for their interest too. For instance, if a child interest with some scientific concepts and enjoy during activities with those contents, he/she could show more self-efficacy (Simsar, 2016). In this case, preservice teachers’ mastery experiences speak to their prior experiences with science and teaching science. Based on interviews and observation data, there were two main types of mastery experiences most stated by participants: teaching experiences and taking science classes due to the coded by researchers (see Figure 2). Figure 2 shows that preservice teachers’ science class experiences were more frequently brought up in the interviews and had several positive and negative codes on participants’ self-efficacy beliefs. Likewise, teaching experiences also had some positive and negative codes. Interestingly for these participants, science class experiences had more positive codes than its negative codes for preservice teacher self-efficacy.

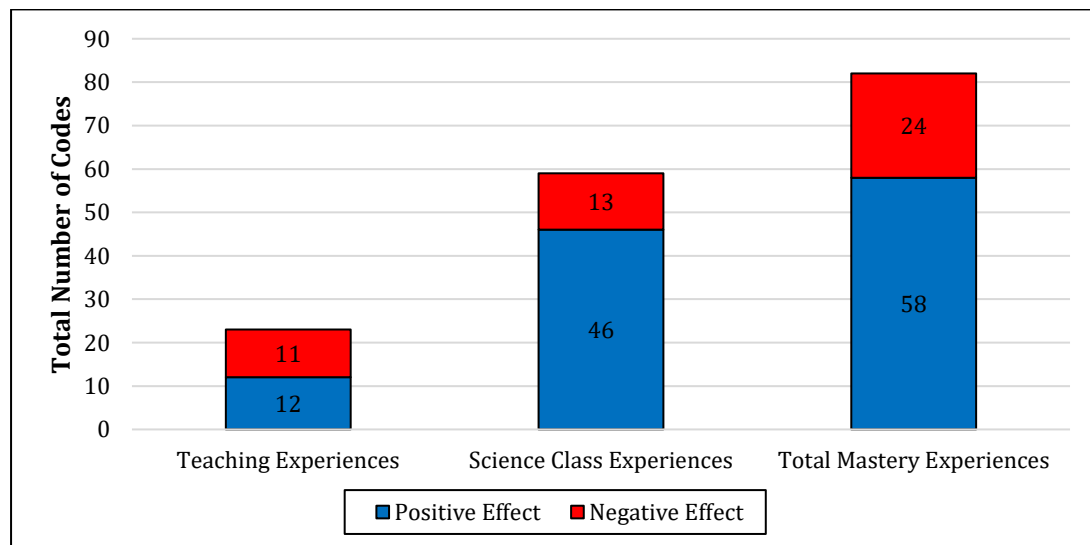


Figure 2. Influence of mastery experiences on self-efficacy beliefs

Teaching experiences refers to preservice teachers' practicum experiences. During this time, preservice teachers had opportunities to teach science activities and participate in leading science class. They also had opportunity to gain feedback and to observe their mentor teacher. For the three participants in this study, teaching experiences had some positive and negative codes for preservice teachers' self-efficacy beliefs. Related with the importance of teaching experiences, PT1 stated that

"I think it's all great, but I just wish I had a little more direction so I could know, Oh I'm good at teaching (science) or I'm not good at teaching (science)."

She also concluded that she viewed her science teaching experiences as hard when compared with reading and language arts teaching due to the related science standards. She shared:

"Like, I want to make butter with my kids. I did it last year, they loved it. They thought it was so cool, we talked about going from a liquid to a solid and I put it in my lesson plan and I found some standard that I stretched to make it work, but – I think there's only like 15 science standards to begin with on the [state department of education standards] website, as opposed to there's 76 reading and language arts."

Due to the someone's attitudes towards teaching science which is related with her mastery experiences part of the standards and curricula of the classroom, PT2 stated that she does not feel confident when she teaches science:

"Now teaching it (science), I am not confident. I am not confident of the teaching, I just don't feel as comfortable to teach as I am teaching reading and math. That's what we mostly see in schools [when we student teach at the practicum placement]. So science and social studies are my two subjects that I am weak at."

Science class experiences refer to preservice teachers' experiences in their science classes which were taken from their elementary to college levels, including the science methods course. From the interviews, each participant had different kinds of K-16 science experiences, in large part because of their science class teachers' instructional approach, such as relying on direct instruction or conducting more hands-on activities. For example, PT2 stated that:

"In my marine biology [class], I remember, we would dissect of a lot of animals. A baby shark, but I don't remember what kind of it was. We dissected many things. It was really hands on. So I really enjoy marine biology class."

PT3 also shared her sentiment around the importance of hands-on activities when reflecting on her experiences in the science methods course due to the previous science teacher:

"Like today (in Teaching Science in Elementary School methods course), we did something with rocks and exploring, comparing, and asked questions using inquiry, things like that. So, Yeah [the methods course professor] is always doing experiments with us. And that helps me as a teacher or future teacher too, within doing that every day that kind of made it permanent in my brain: 'do experiments.'"

In addition, she also pointed out that her previous science class had an unclear impact on her science teaching self-efficacy beliefs:

"I was in sixth grade. We did this, I think this is science, right we were doing test where we tested light bulbs to test which one lights longer. It was ok experiment...I don't exactly know how that help me science specifically. Except for the fact that. It was an experiment, and involved interacting."

Physiological and Emotional States

Physiological and emotional states refer to one's interest or attitudes towards something. In this case, it refers preservice teachers' interest and emotional feelings toward science and science teaching. The data were collected by asking questions about prior interest and current interest with science. Participants shared their thoughts about science while talking about their prior science classes and they also shared whether these were positive or negative for them (see Figure 3).

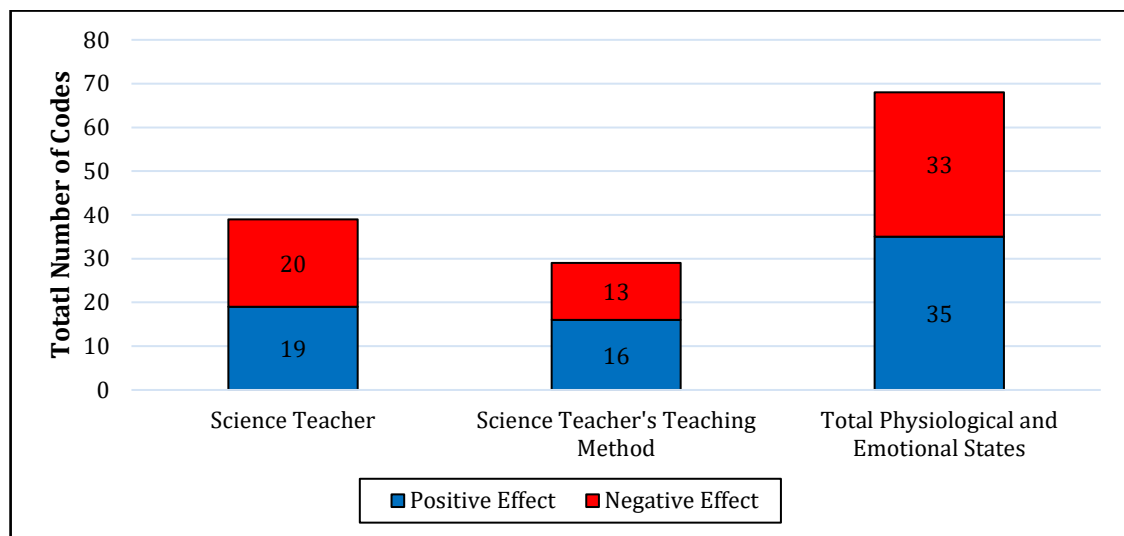


Figure 3. Influence of physiological and emotional states on self-efficacy beliefs

Interestingly, much of the feelings and attitudes described by the preservice teachers were in reference to the teachers of their previous science classes and their corresponding teaching methods. To describe her attitudes toward the importance of classroom science experiences as being hands-on, PT2 stated that:

“That was my chemistry class, on the other hand, it was more my teacher did do more hands on. He did like here is the book, this is what we were doing for this lesson, this is what we would do for next class, and here is the test. So, it was more like it wasn't hands on how it should be. Because science I feel it has to be hands on. If not, you don't really understand it.”

In this statement, she shows how her teachers' effect on her interest in science was not positive because of his reliance on direct instruction techniques. From this quote, one could take the stance that she believes that science must be hands-on and that it should always be taught in that way. However, in contrast, PT1 shared that,

“In the 7th grade, we had this teacher, Ms. B. She did something that we've never done before. She gave us a book about e. coli. It was – I mean, it's a novel. We had assigned readings and that was one of the most interesting things. It's the only time I've had a science teacher that had us read a science-based novel. It was good. I liked it and I think I even went on to read another books after that. She was a great teacher. She's the only science teacher I remember in middle school.”

In this experience, PT1 has a positive feeling toward her science teacher because of her teaching style even if her science class teacher used direct instruction teaching methods or activities that

might not appear to be “hands-on”. These two examples show that teachers and teaching methods may have positive and/or negative physiological and emotional effects on preservice teacher’s self-efficacy beliefs about science teaching in the future.

Social Persuasion

Social persuasion is related with people’s behavioral changes due to their social interaction with others (Stajkovic & Luthans, 1998). In this case, preservice teachers’ sources of social persuasion could impact their self-efficacy belief about science teaching due to their social interaction and group work in science method course, such as those that occur with their peers and teachers during science experiences (see Figure 4).

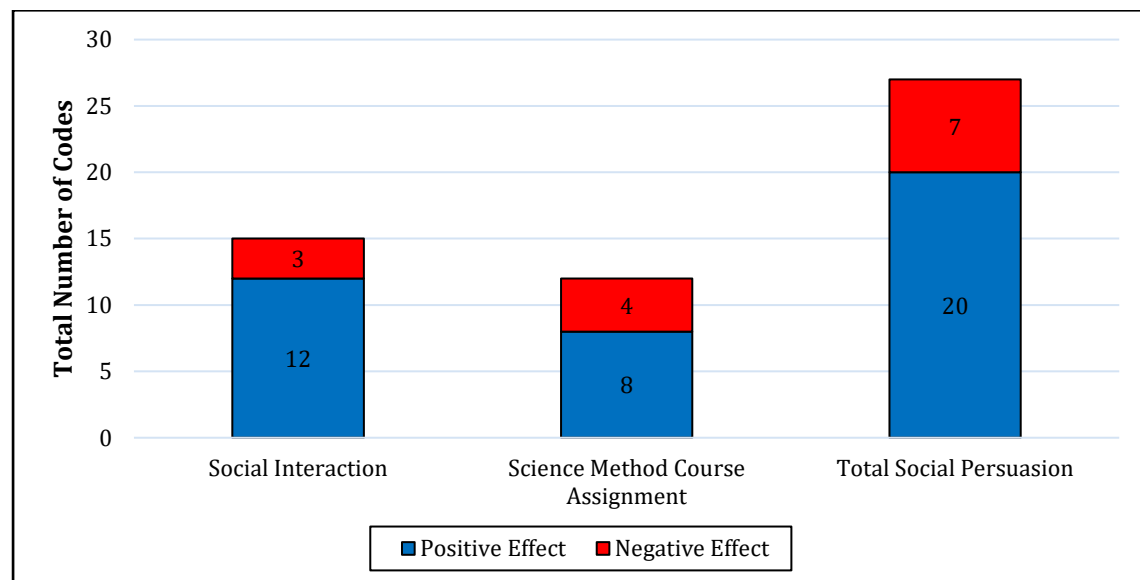


Figure 4. Influence of social persuasion on self-efficacy beliefs

One of the most salient sources came from their peer collaboration. Interviews and observations showed that most of the social persuasion effects were seen in data collected from participant observations. Because of their science methods course, preservice teachers’ science teaching self-efficacy could be improved from their collaborative experiences and group work. From the field notes from PT2’s observation, the researchers noted that this participant was interested in sharing her own experiences with others during group work:

“PT2 said “this should be in science center” and when she tries to explained to her friends what they should do with sunflower seeds, PT2 shared her stories about how she planted sunflower when she was younger.”

In this experience, PT2’s stories about plants and her interest with science objects are shared while she and her peers were talking about seeds. In another example from an observation of PT1 during the same seed and plant activity, there is evidence that social interaction:

“Not a lot of on-topic discussion – group discussed football plans & an assignment in a different methods course primarily as they were making their leaf rubbings. Group discussed boyfriends and Pinterest at bean seed center.”

In this experience, PT1 also joined to her peers while talking about other assignments. This happened because none of the table may have had interest with their task about the particular science topics addressed around soil, seeds, and plants. It means that, if a person stated in a group of people who doesn't care with that contents, that person also may impact from the groups' communication.

Vicarious Experiences

Vicarious experiences are related with one's observation of another's behaviors and its effects on other people's behaviors. Data analyzes of study about preservice early childhood teachers' science teaching self-efficacy beliefs and their vicarious experiences were shown in Figure 5.

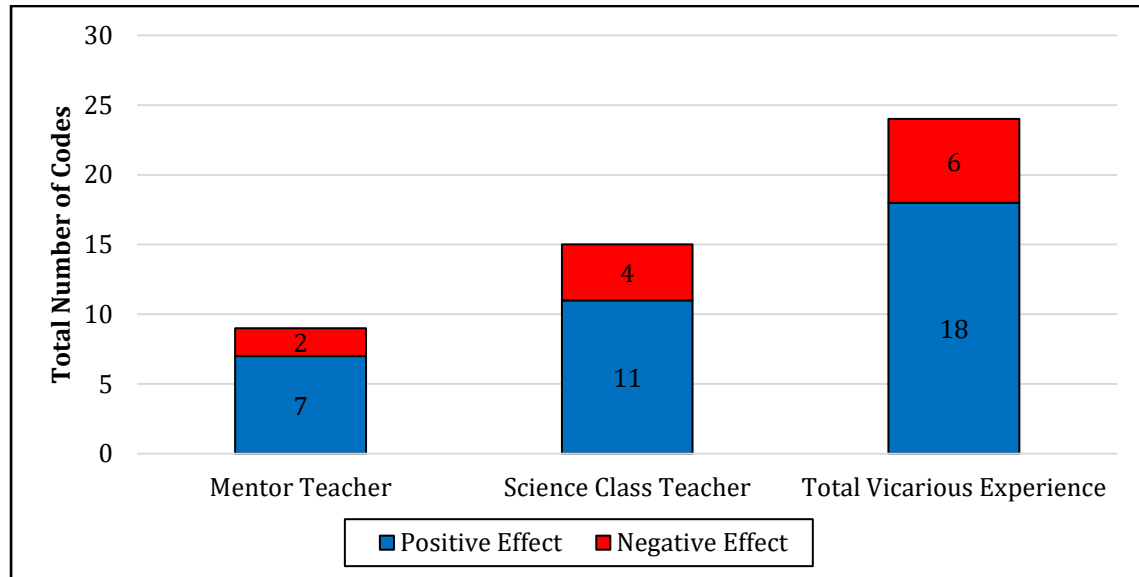


Figure 5. Influence of vicarious experiences on self-efficacy

In this case, preservice teacher' sources of vicarious experiences are their science class teachers and mentor teachers. The attitudes and behaviors held by these two groups of people while teaching and modeling have the potential to have positive and negative impacts on self-efficacy beliefs. Figure 5 shows that preservice teachers' vicarious experiences have positive and negative codes on their self-efficacy beliefs. Based on the Figure 5, Mentor Teachers had positive and negative codes on self-efficacy beliefs. Similarly, Science Class Teacher also has positive influences and negative influences. Related with mentor teachers' impacts on preservice teachers' science teaching, PT1 shared her experiences and stated that:

“Um, I've never seen science [in the practicum classroom]. I've never seen science being taught whole group. [The mentor teacher] like puts out a science center but the kids don't do anything there. It's not effective.”

From here PT1, stated that her bad experiences during teaching practicum, she may conclude that mentor teacher doesn't give science it is because it is hard to teach and/or it's is not really important as much as other. That is why she may have low self-efficacy beliefs against science in early childhood classroom. However, if a preservice teacher had more chance to observer her

mentor teachers during science teaching, she may have pre self-efficacy beliefs than others. For instance, PT2 stated about her mentor teacher that:

“She really tries to show me and model good ways to include these subjects. For instance, the main topic for next week is community helpers. And what she is doing that she is doing a lot of social studies lesson plans. At the end of the day, to incorporate wonders curriculum. But, it’s hard to incorporate different things like science and social studies because of the curriculum that we have to teach.”

Related with science class teachers and his impacts on preservice teachers’ self-efficacy beliefs on science teaching, PT2 stated that:

“Because I remember in High school, we had (Marine Biology), biology, chemistry. You really know like little things for making vinegar and baking powder. I mean baking soda. It’s going to (up) like how we made volcanos. Then we would realize “Oh man I like chemistry class. WOW. That’s what we did. Then we would just connect like I feel like my students when they get to chemistry or something, they are not even known that’s what. Because we don’t do experiments. They don’t really have hands on with science. I think that’s really important, but I guess we have to teach for the [standardized testing].”

In here, preservice teachers discuss what she had experiences about science and how it should be. She disagreed how she learnt when she was younger and she shared her feeling how it should be done. In relation to the complexity of what should be done in a science class, PT3 described her experiences in the science methods course as such:

“[The methods course professor] is always doing experiments with us. And that helps me as a teacher or future teacher to within doing that every day that kind of made it permanent in my brain to do experiments. He always has questions for teachers- students to ask questions, as a scientist you need to -- always need to ask good questions. So it’s actually it’s probably one of the more productive science classes that I have had just because of the interactions.”

From this quote, PT3 shared what she learnt from her professor and how science could be taught to children. She shared positive feeling that how her professors instruction style impacts her thoughts about science teaching. Related with that, PT1 also stated her positive feelings for her science course that:

“Dr. J. has a big influence to my attitudes toward science. Because he makes this flies. Everything was always exciting and new in that class. However, in my elementary science class, it wasn’t fun. They (teachers) didn’t make it fun. It was pressure for me.”

This quote means that PT1’s professor’s teaching experiences had a good influence on their science teaching skills. Probably she thinks that, teaching science should be more fun and students could be enjoying from it. Because of her previous experiences which teacher made not it fun, her science course professor had more positive impacts on her self-efficacy beliefs.

Curriculum and Standards

All in all, the findings show that preservice early childhood teachers’ self-efficacy beliefs about teaching science are indeed influenced by their mastery experiences, physiological and emotional states, social persuasion, and vicarious experiences. However, an additional category emerged as preservice teachers’ concerns about curriculum and standards also influence their self-efficacy beliefs (see Figure 6).

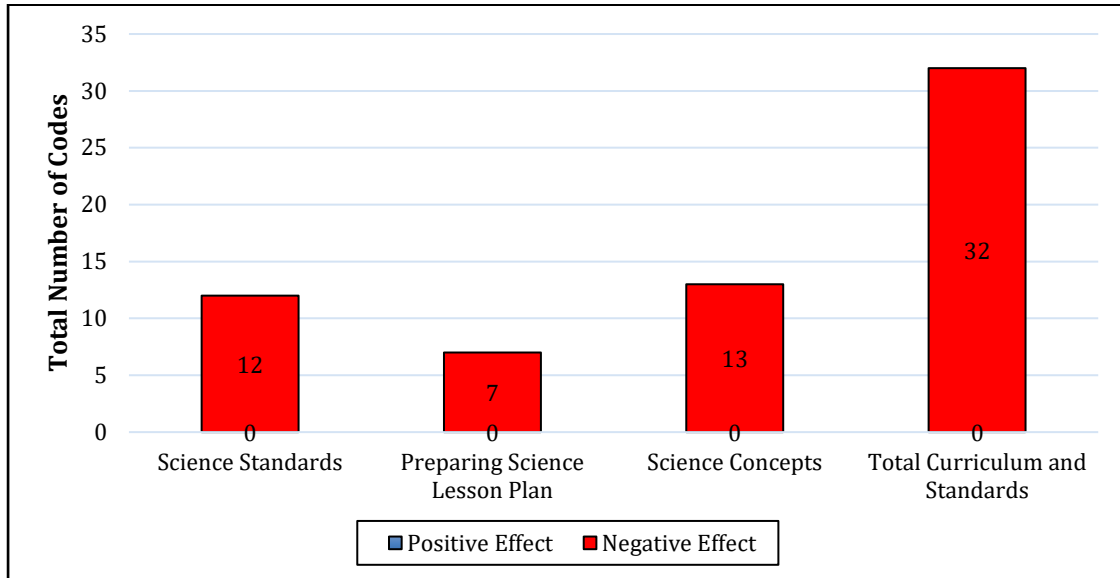


Figure 6. Influence of science curriculum and standards

Figure 6 shows the level these factors have influence on preservice teachers' science self-efficacy beliefs. It is important and, indeed, expected that preservice early childhood teachers will use the appropriate curriculum and standards for science when designing and implementing lesson plans for their students. Yet this was a concern for the preservice teacher participants in this study. When answering the question "What worries or concerns might you have about teaching science to students?", PT2 stated that:

"I have plenty. I was always not comfortable. Because I am not comfortable with many of the concepts."

Echoing this sentiment, PT1 stated that:

"I just don't really know where to start with kindergarten, what they should know or what they should be learning. The standards are just not helpful."

From the quotes are related with science curriculum and standards, the participants stated that standards were not help them to create and teach science. Because of that they don't feel comfortable to teach science in early childhood classroom. That is why curriculum and standards may have negative influence on their self-efficacy beliefs.

Source of Self-Efficacy Beliefs

The interview and observational data show that there were several sources that focused on preservice early childhood teachers' previous and current science experiences. In Figure 7, each of the data were organized under the related primary codes conceptualized by Bandura's theory of sources of self-efficacy: mastery experiences, vicarious experiences, social persuasion, and physiological and emotional states.

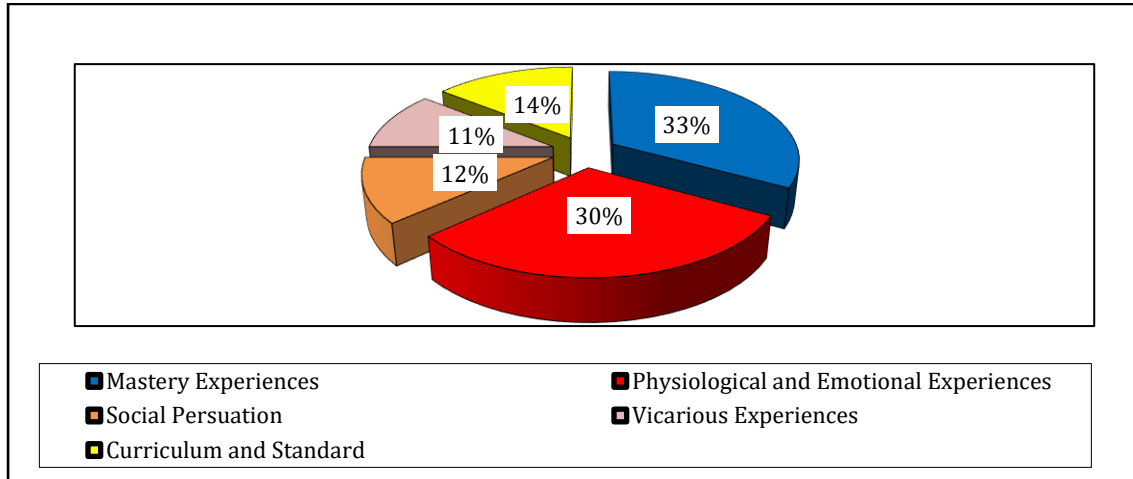


Figure 7. Source of self-efficacy beliefs

From this data set, mastery experiences have more influences than other sources for these participants as they were referenced the most. Vicarious experiences seemed to have low impacts on self-efficacy beliefs. In Figure 7, most of the social persuasion sources came from observational data. Because of the collaborative nature of the methods course activities, social persuasion sources were observed mostly in the science teaching method course.

Effects of Experiences on Self-Efficacy Beliefs

To examine the level of each source as a negative and positive influence on self-efficacy beliefs, all the data were organized as their positive and negative effects on preservice early childhood teachers' science teaching self-efficacy beliefs (see Figure 8).

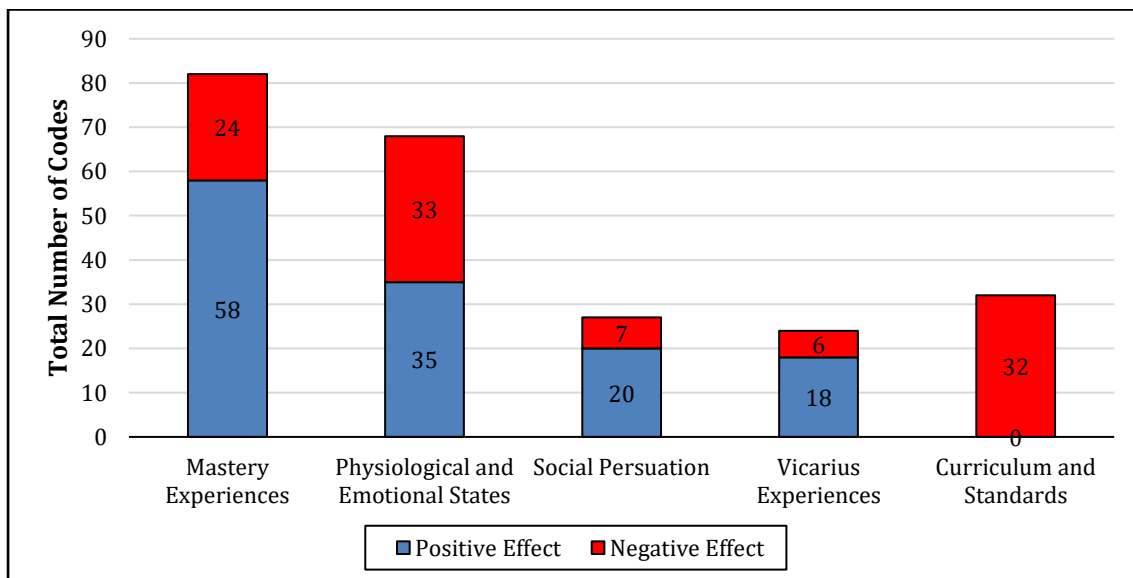


Figure 8. Effects of experiences on self-efficacy beliefs

Figure 8 shows that preservice teachers' concerns about curriculum and standards and physiological and emotional states have more negative codes on self-efficacy beliefs than other sources. Figure 8 also shows that mastery experiences had more positive codes on self-efficacy beliefs than other sources. Additionally, physiological and emotional states have slightly equal positive and negative codes.

Discussion and Conclusion

The current study examined preservice early childhood teachers' science teaching self-efficacy beliefs by using semi-structured interviews and observations for three preservice teachers. The results demonstrated that mastery experiences had more positive and negative impacts of experiences as a sources of preservice teachers' science teaching self efficacy beliefs. Related with mastery experiences, this finding resonates with other work that states preservice teachers' science method courses and previous science activities or experiences have important and lasting impacts on their beliefs (Avery & Meyer, 2012; Kırık, 2013; Mulholland et al., 2004; Saçkes et al., 2012; Watters & Ginns, 2000). Similarly, findings of the current study also suggest the importance of science method courses and previous science experiences. Science method course can have significant influence on preservice teachers' self-efficacy beliefs if it is designed by the giving more theoretical and practical teaching experiences to preservice teachers (Avery & Meyer, 2012; Çığ, 2020; Saçkes et al., 2012; Vural & Hamurcu, 2008; Watters & Ginns, 2000). Likewise, the results of the current study suggest that science method courses, prior science classes and preservice teachers' elementary and high school teachers have important influence on self-efficacy beliefs on science teaching. Resonating with this, Vural and Hamurcu (2008) also found that science method courses had positive influences on preservice teacher self-efficacy beliefs. It could be said that teacher education programs could focus on giving more science methods courses. The current study also agrees with this finding with effects of science class teacher's impacts on preservice teacher self-efficacy beliefs which reported by the preservice teachers. Mulholland et al. (2004) stated that the number of science classes taken by preservice teachers during high school education had significant impacts on their science teaching efficacy beliefs. Similarly, the present study underlined the importance of having more science subject studies during K-12 education for preservice early childhood teacher. However, it is also found that, previous teachers' teaching method on science had some teacher reported negative effects on their students' self-efficacy beliefs and also attitudes towards science. Because of that, not only having more science classes but they also have good teaching method such as hands-on experiences. The results also show that preservice teachers' previous science experiences, such as those during their K-12 education or science method course experiences, have lasting impacts on their self-efficacy beliefs. These findings suggest that preservice teacher's educational background had more impacts on their self-efficacy beliefs than may have been previously thought in the field.

In addition, Kırık's (2013) study showed that attitudes towards science teaching influence preservice teachers' self-efficacy beliefs. Findings of this current study showed that preservice teachers' physiological and emotional states towards science and science teaching are one of the most impacting factors on their self-efficacy beliefs. The findings of the present study demonstrate that physiological and emotional states toward science had slightly equal positive and negative influences on self-efficacy beliefs. It is because of their teachers' science teaching method.

Englehart (2010) found that preservice teachers' science teaching experiences and science curriculum and standards have impacts on self-efficacy beliefs. Research has shown that teaching experiences have significant impacts on preservice teacher's science teaching self-efficacy (Aslan & Sağır, 2008; Cantrell et al., 2003; Cone, 2009; Englehart, 2010; Kiremit, 2006; Kırık, 2013; Plourde, 2002; Simsar, 2016; Woolfolk, 2000). Likewise, findings of the current study show that preservice teachers' concerns about curriculum and standards and their teaching experiences had significant effects on their self-efficacy beliefs. In contrast, it is also found that their preservice teaching experiences have positive effects on their self-efficacy beliefs. However, this may not be long-lived, as Aslan and Sağır (2008) specified that when preservice teachers enter their practicum to teach science, their self-efficacy decreases as they often feel under prepared. Related with vicarious experiences, one of the most important factors found that science class teachers can greatly impact preservice teachers (Avery & Meyer, 2012; McKinon & Lamberts, 2014; Velthuis et al., 2014; Worch et al., 2012). In addition, mentor teachers also had positive and negative influences on their preservice teachers' science teaching efficacy beliefs (Simsar, 2016). The findings of the present study suggest that preservice teachers' previous science class experiences, their science class teachers and related teaching styles, and their mentor teachers have positive influence on their self-efficacy beliefs. In addition, the current study's findings seem to be consistent with those of Cantrell et al. (2003) in that having opportunities to teach science is related to preservice teachers' science teaching self-efficacy beliefs. When compared to Cantrell's (2003) study, the practicum experience associated with the science methods course is not an extensive teaching experience. Yet, when considered alongside findings from other studies such as those by Ginns et al. (1995) and Bleicher and Lindgren (2005), the correlation between teaching science during teaching practicum and self-efficacy beliefs is acceptable.

The findings of the current study suggest that early childhood teacher educators should support preservice teachers by allowing them to have a greater number of science experiences in general. Science activities conducted with children should be more hands-on and inquiry based to improve preservice teachers' attitudes towards science. Early science learning experiences can help preservice early childhood teachers in the future. In other words, teachers who have high efficacy beliefs about science teaching can be more effective in their classroom while enhancing their students' scientific knowledge. Early childhood teachers often have a difficult time when integrating science activities by using related curriculum and standards. Policymakers and teacher educators should focus on ways to help preservice early childhood teachers more carefully learn to integrate science with other subjects such as language arts, mathematics, and play.

References

- Ashton, P. (1984). Teacher efficacy: A motivational paradigm for effective teacher education. *Journal of Teacher Education*, 35, 28-32.
- Ashton, P. T., & Webb, R. B. (1986). Making a difference: Teachers' sense of efficacy and student achievement. Longman, New York.
- Aslan, O., & Sağır, S. U. (2008). *The determination of the preservice science and technology teachers' scientific attitudes, self-efficacy levels and affecting factors*. Retrieved from: <http://www.anadolu.edu.tr>.
- Avery, L. M., & Meyer, D. Z. (2012). Teaching science as science is practiced: Opportunities and limits for enhancing preservice elementary teachers' self-efficacy for science and science teaching. *School Science and Mathematics*, 112(7), 395-409.
- Bandura, A. (1977a). Self-efficacy: toward a unifying theory of behavioral change. *Psychological Review*, 84(2), 191-215.
- Bandura, A. (1977b). *Social learning theory*. Upper Saddle River, NJ: Prentice-Hall.
- Bandura, A. (1994). Self-efficacy. In V. S. Ramachandran (Ed.), *Encyclopedia of human behavior* (Vol. 4, pp. 71-81). New York: Academic Press. (Reprinted in H. Friedman [Ed.], *Encyclopedia of mental health*. San Diego: Academic Press, 1998). Retrieved from <http://www.uky.edu/~eushe2/Bandura/BanEncy.html>.
- Banilower, E. R., Smith, P. S., Weiss, I. R., Malzahn, K. A., Campbell, K. M., & Weis, A. M. (2013). Report of the 2012 national survey of science and mathematics education. *Horizon Research, Inc.(NJI)*.
- Bayraktar, S. (2011). Turkish preservice primary school teachers' science teaching efficacy beliefs and attitudes toward science: The effect of a primary teacher education program. *School Science and Mathematics*, 111(3), 83-92.
- Bleicher, R. E., & Lindgren, J. (2005). Success in science learning and preservice science teaching self-efficacy. *Journal of Science Teacher Education*, 16(2005), 205-225.
- Bulunuz, M., & Jarrett, O.S. (2010). Developing an interest in science; background experiences of preservice elementary teachers. *International Journal of Environmental & Science Education*, 5(1), 65-84.
- Bursal, M. (2012). Changes in American preservice elementary teachers' efficacy beliefs and anxieties during a science methods course. *Science Education International*, 23(1), 40-55. Retrieved from <http://search.proquest.com/docview/1037908167?accountid=4840>.
- Büyüköztürk, Ş., Çakmak, E. K., Akgün, Ö. E., Karadeniz, Ş., & Demirel, F. (2017). *Bilimsel araştırma yöntemleri*. (23. Baskı). Ankara: Pegem Akademi.
- Cantrell, P., Young, S., and Moore, A. (2003). Factors affecting science teaching efficacy of preservice elementary teachers. *Journal of Science Teacher Education*, 14(3), 177-192.
- Çığ, O. (2020). Yapılandırmacı fen öğrenim sürecinde çocuğun ve eğitimcinin rolü. *Erken Çocukluk Fen Eğitiminde Temel Konular ve Güncel Yaklaşımlar*, (1. Baskı, ss. 107-124). Ankara: Nobel Akademik Yayıncılık.
- Cone, N. (2009). Community-based service-learning as a source of personal self-efficacy: Preparing preservice elementary teachers to teach science for diversity. *School Science and Mathematics*, 109(1), 20-30. doi: 10.1111/j.1949-8594.2009.tb17859.x.
- Denham, C. H., & Michael, J. J. (1981). Teacher sense of efficacy: A definition of the construct and a model for further research. *Educational Research Quarterly*, 6(1), 39-63.
- Duschl, R. (2008). Science education in three-part harmony: Balancing conceptual, epistemic, and social learning goals. *Review of Research in Education*, 32(1), 268-291.
- Englehart, D. S. (2010). Contrast of the science teaching practices of two preservice early childhood educators. *Florida Association of Teacher Educators Journal*, 1(10), 40-54.
- Fulp, S.L. (2002). 2000 national survey of science and mathematics education: Status of elementary school teaching. Horizons Research, Inc. Available online: http://www.horizonresearch.com/reports/2002/2000survey/elem_sci.php

- Gall, M. D., Borg, W. R., & Gall, J. P. (1996). *Educational research: An introduction*. Longman Publishing.
- Gibson, S., & Dembo, M. H. (1984). Teacher efficacy: A construct validation. *Journal of Educational Psychology, 76*(4), 569-582
- Ginns, I. S., Tulip, D. F., Watters, J. J., & Lucas, K. B. (1995). Changes in preservice elementary teachers' sense of efficacy in teaching science. *School Science and Mathematics, 95*(8), 394. Retrieved from <https://login.proxy.lib.fsu.edu/login?url=http://search.proquest.com/docview/195203144?accountid=4840>.
- Kazempour, M. (2014). I can't teach science! A case study of an elementary preservice teacher's intersection of science experiences, beliefs, attitude, and self efficacy. *International Journal of Environmental & Science Education, 9*(1), 77-96.
- Kiremit, Ö. H. (2006). *Comparison of preservice science teachers' self-efficacy beliefs about biology*. (Doctoral dissertation), Retrieved from Dokuz Eylül University Social Science Institute Dissertation and Thesis.
- Kırık, O. T. (2013). Science teaching efficacy of preservice elementary teachers: Examination of the multiple factors reported as influential. *Research in Science Education, 2013*(43), 2497-2515. doi: 10.1007/s11165-013-9357-y
- McKinnon, M., & Lamberts, R. (2014). Influencing science teaching self-efficacy beliefs of primary school teachers: A longitudinal case study. *International Journal of Science Education, 4*(2), 172-194. doi: 10.1080/21548455.2013.793432.
- McMillan, J. H. (1996). *Educational research: Fundamentals for the consumer* (3th ed.). New York: Longman.
- Merriam, S. B. (1998). *Qualitative research and case study applications in education. Revised and expanded from "Case Study Research in Education"*. San Francisco, CA: Jossey-Bass Publishers.
- Miles, M. B., Huberman, A. M., & Saldana, J. (2014). *Qualitative data analysis: A methods sourcebook*. Sage.
- Moustakas, C. (1994). *Phenomenological research methods*. Thousand Oaks, CA: Sage.
- Mulholland, J., Dorman, J. P., & Odgers, B. M. (2004). Assessment of science teaching efficacy of preservice teachers in an Australian university. *Journal of Science Teacher Education, 15*(4), 313-331. Retrieved from <http://search.proquest.com/docview/62079956?accountid=4840>
- Plourde, L. A. (2002). The influence of student teaching on preservice elementary teachers' science self-efficacy and outcome expectancy beliefs. *Journal of Instructional Psychology, 29*(4), 245-253.
- Protheroe, N. (2008). Teacher Efficacy: What is it and does it matter? *Principal, 87*(5), 42-45.
- Putman, S. M. (2012). Investigating teacher efficacy: Comparing preservice and inservice teachers with different levels of experience. *Action in Teacher Education, 34*(1), 26-40.
- Riggs, I. (1988). The development of an elementary teachers' science teaching efficacy belief instrument. Dissertation Abstracts International.
- Rizvi, M., & Elliot, B. (2005). Teachers' perceptions of their professionalism in government primary schools in Karachi, Pakistan. *Asia-Pacific Journal of Teacher Education, 33*(1), 35-52.
- Ersoy, F. (2019). Fenomenoloji. In A. Saban & A. Ersoy (Editors), *Eğitimde nitel araştırma desenleri* (3rd ed., pp. 81-139). Ankara: Anı Yayıncılık.
- Saçkes, M., Flevares, L.M., Gonya, J., & Trundle, K.C. (2012). Preservice early childhood teachers' sense of efficacy for integrating mathematics and science: Impact of a methods course. *Journal of Early Childhood Teacher Education, 2012*(33), 349-364. doi: 10.1080/10901027.2012.732666.
- Sanders, P. (1982). Phenomenology: A new way of viewing organizational research. *Academy of Management Review, 7*(3), 353-360.
- Simsar, A. (2016). Turkish preservice early childhood teachers' science teaching self efficacy beliefs. Retrieved from http://purl.flvc.org/fsu/fd/FSU_FA2016_SIMSAR_fsu_0071E_13558.
- Simsar, A., & Dogan, Y. (2020). Mentor teachers' mentoring practices in science teaching: Views of pre-service early childhood teachers. *Educational Policy Analysis and Strategic Research, 15*(1), 94-113. doi: 10.29329/epasr.2020.236.6
- Soodak, L. C., Podell, D. M., & Lehman, L. R. (1998). Teacher, student, and school attributes as predictors of teachers' responses to inclusion. *The Journal of Special Education, 31*(4), 480-497.

- Stajkovic, A. D., & Luthans, F. (1998). Social cognitive theory and self-efficacy: Going beyond traditional motivational and behavioral approaches. *Organizational Dynamics*, 26(4), 62-74.
- Stein, M. K. & Smith, M. (2011). *5 Practices for orchestrating productive mathematics discussions*. Reston, VA: National Council of Teachers of Mathematics.
- Strandberg, M. & Lindberg, V. (2012). Feedback in a multiethnic classroom discussion: A case study. *Intercultural Education*, 23(2), 75-88.
- Tschannen-Moran, M., & Hoy, A. W. (2001). Teacher efficacy: Capturing an elusive construct. *Teaching and Teacher Education*, 17(7), 783-805.
- Tschannen-Moran, M., Hoy, A. W., & Hoy, W. K. (1998). Teacher efficacy: Its meaning and measure. *Review of Educational Research*, 68(2), 202-248.
- Velthuis, C., Fisser, P., & Pieters, J. (2014). Teacher training and preservice primary teachers' self-efficacy for science teaching. *Journal of Science Teacher Education*, 25(2014), 445-464. doi: 10.1007/s10972-013-9363-y.
- Vural, D. E., & Hamurcu, H. (2008). Preschool teacher candidates' self-efficacy beliefs regarding science teaching lesson and opinions about science. *Elementary Education Online*, 7(2), 456-467.
- Watters, J., & Ginns, I. (2000). Developing motivation to teach elementary science: Effect of collaborative and authentic learning practices in preservice education. *Journal of Science Teacher Education*, 11(4), 301-321.
- Woolfolk, A. H. (2000). "Changes in teacher efficacy during the early years of teaching" *Paper Presented at the Annual Meeting of the American Educational Research Association*, New Orleans, LA. Session 43:22, Qualitative and Quantitative Approaches to Examining Efficacy in Teaching and Learning. The Ohio State University.
- Worch, E.A., Li, L., & Herman, L. (2012). Preservice early childhood teachers' self-efficacy and outcome expectancy for ICT integration in science instruction. *Education Research and Perspectives*, 39(1), 90-93.

Authors

Contact

Dr. Ahmet SIMSAR has been working as an assistant professor at Early Childhood Education Department of Kilis 7 Aralık University. His research interest are focused on early childhood science education and teacher education. He also had some studies about early childhood refugee children and their education.

ahmetsimsar@kilis.edu.tr

Dr. Shannon G. Davidson is a postdoctoral scholar in the School of Teacher Education at Florida State University. Her research focuses on teaching and learning in science education, particularly at the elementary level. She is also interested in how firsthand science experiences shape teachers' orientations to their classroom practices in science teaching.

ShannonGDavidson@gmail.com