

Field Experiences, Mentoring, and Preservice Early Childhood Teachers' Science Teaching Self-Efficacy Beliefs

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Abstract

In this study relationships between preservice early childhood teachers' self-efficacy beliefs and their mentor teachers' mentoring were examined. Quantitative research method was used in the study by the using multivariate data collections. The Science Teaching Efficacy Belief Instrument (STEBI) was administered to 96 pre-service teachers and mentor teachers. Time spent teaching and observing science was recorded also recorded by participants by the using time trackers. The Mentoring for Effective Science Teaching (MEST) instrument measured perceptions of the teachers' mentoring activities, including modeling and feedback. Correlational analyses estimated the relationship between the preservice and mentor teachers' self-efficacy beliefs, beliefs and time spent teaching, and beliefs and modeling and feedback. The findings suggest that mentor teachers play an important role in the preparation of preservice teachers, and that this role is particularly true for those mentors with higher science teaching self-efficacy beliefs. It also showed that how teaching practices have significant roles while preparing future teachers. For teacher education program could be pay attention to teaching practices while giving a decision for choosing mentor teachers. For future researchers may also look at the different sections of mentoring practices and their impacts on preservice teacher's teaching skills.

Introduction

In recent years there has been considerable interest in early childhood science teaching and learning. Presumably, this is a consequence of research findings in developmental and cognitive psychology suggesting that young children are capable of concept-based learning (Gelman, 2000; Gelman & Brenneman, 2004). Thus, educators and researchers maintain that young children's familiarity with science practices and the language of science can positively influence the development of their scientific thinking and conceptual understanding (e.g., Greenfield et al., 2009). It follows that high-quality science experiences in preschool should lead to increased long-term science achievement and engagement (Eshach & Fried, 2005; French, 2004). Yet, despite the recent emphasis on preschool science education, it is claimed that there is a tendency for early childhood teachers to teach science less often than other school subjects (Dogan & Simsar, 2018; Flear, 2009; Simsar, 2018; Simsar & Dogan, 2019; Tu, 2006). One plausible explanation for this is that preschool or prekindergarten teachers lack confidence in teaching science (Appleton, 2008; Flear, 2009; Simsar & Dogan, 2019). Furthermore, preschool teachers are

often unprepared to teach science, and science instruction is often ineffective and poorly aligned with accepted high-quality science instruction (Fleer, 2009; Greenfield et al., 2009; Tu, 2006). This could possibly explain the troubling finding from a large-scale study conducted in the United States that children's school readiness in science lags behind other domains (Greenfield et al., 2009). Relatedly, despite rich pedagogical materials for teachers, and extensive teacher education focused on science teaching, many early childhood teachers struggle to adopt an inquiry-based paradigm. Instead, they often resort to a knowledge transmission approach.

Presumably, such problems can be traced back to preservice teachers' education and training, including the nature and extent of their classroom teaching experiences. Researchers suggest that preservice teachers' practical teaching experiences present a major challenge in terms of developing their instructional practices, pedagogical knowledge, and science teaching skills, as well as the extent to which their mentor teachers support their growth and development (Carrier, 2009; Plourde, 2002; Soprano & Yang, 2012). The proffered solution offered by Soprano and Yang (2012) is to provide opportunities for preservice teachers to see the outcomes of their teaching, and also to receive positive feedback from their mentor teachers. They claim that such an approach should lead to an increase in preservice teachers' confidence in their teaching, and thereby a positive change in their self-efficacy beliefs. Relatedly, it is possible that the problems, successes, and challenges that preservice teachers experience when teaching early childhood science are related to their mentor teachers' mentoring practices (e.g., modeling and providing feedback, spending time teaching, and providing opportunities to teach science). In an effort to address this possibility, the current study examined the relationship between preservice teachers' science teaching efficacy beliefs and the mentor teacher's science teaching efficacy beliefs, the time spent teaching and observing science teaching in the classroom, and the mentor teachers modeling and feedback during the field experience.

Theoretical Rationale

The importance of teachers' self-efficacy beliefs is well established in the literature (e.g., Ashton, 1984). First developed by Bandura (1977), the construct of self-efficacy refers to individuals' beliefs in their own capabilities for being successful at a specific task such as teaching science. According to Bandura (1977), self-efficacy beliefs emerge as individuals interpret information concerning their own capabilities. The sources of this information include mastery experiences, vicarious experiences, verbal persuasion, and psychological or emotional conditions. In general, successful experiences would positively influence an individual's self-efficacy beliefs, whereas experiencing failure would be more likely to lower them. Vicarious experiences, on the other hand, provide a point of reference for social comparison whereby self-efficacy beliefs are shaped by demonstrating and transferring competencies (such as modeling). In contrast, verbal persuasion entails individuals being convinced of their capabilities by others. Then, psychological experiences refer to the affect associated with demonstrating capability in a relevant domain, such as teaching.

Mastery experiences, in the context of pre-service teachers' science teaching self-efficacy would include prior relevant science experiences, such as the number of university science courses taken, (Avery & Meyer, 2012; Englehart, 2010; Hechter, 2011; Palmer, 2006). Master experiences would also include those that pre-service

teachers' acquire during practicum or classroom-based field experiences. Researchers have noted the importance of teaching practices and field experiences for supporting preservice teacher's self-efficacy beliefs about science (Cantrell, Young, & Moore, 2003; Cone, 2009; Plourde, 2002; Wagler, 2011). Indeed, self-efficacy beliefs are considered most malleable during initial teacher education (Henson, 2002) and specifically, during practicum experiences (Klassen & Dursken, 2014). Specific aspects of the practicum could, however, differentially influence pre-service teachers' self-efficacy beliefs. For example, the extent to which a pre-service teacher is allowed to teach science could be relevant. Similarly, teaching observations with constructive feedback, and reflective writing regarding the instructional events (Moody, 2009; Putman, 2012) can influence preservice teachers' self-efficacy beliefs.

During their field experiences, pre-service teachers are typically given opportunities to observe classroom teaching. Tschannen-Moran, Hoy, and Hoy (1998) noted that "Watching others' teach in skillful and adept ways—especially observing admired, credible, and similar models can affect the observers personal teaching competence" (p.230). It follows that observing early childhood science being effectively taught in the classroom would influence pre-service teachers self-efficacy beliefs. Beyond such vicarious experiences, the more focused approach of modeling can potentially be more beneficial. According to Tschannen-Moran and colleagues (1998, 2001, 2007) successful modeling can increase the observer's efficacy expectations. Being a successful role model, however, includes more than simply demonstrating effective classroom teaching. It also includes engaging with the observer in supportive ways such as offering constructive feedback. It follows that classroom teachers who serve as good role models as well as effective mentors would help preservice teachers improve their teaching skills and increase their self-efficacy beliefs.

Effective mentoring of beginning teachers is important so that they can become effective practitioners (Andrews & Quinn, 2005). According to Johnson (2008) a mentor is an experienced teacher who is skilled in understanding standards, is able to transmit effective teaching strategies, and can engage in open communication with beginning and/or preservice teachers. Thus, the role of a mentor is to be an encourager, role model, feedback giver, observer, and supporter (Haigh & Ward, 2004). In the current study, mentoring was viewed as the provision of guidance and feedback concerning science teaching during the teaching practicum, and helping the preservice teachers feels more confident while teaching science. This is a perspective that emphasizes the importance of providing the beginning teacher with regular constructive feedback concerning his or her performance.

Providing a pre-service teacher with constructive feedback concerning his or her classroom teaching can be considered a type of social persuasion. Recent research findings suggest that social persuasion shape preservice teacher's self-efficacy beliefs in both positive and negative ways (Amalia & Imperiani, 2013; Moody, 2009). For example, Tschannen-Moran, et al. (1998) found that mentor teachers' negative feedback on preservice teachers' performance was associated with decreases in their self-efficacy. In contrast, other researchers reported that the provision of written, oral, and evaluative feedback by mentor teachers on pre-service teachers' science lesson plans had positive effects on the pre-service teachers' planning (Amalia & Imperiani, 2013; Hudson et al., 2005).

Self-efficacy beliefs are considered to be one of the most important predictors of teachers' instructional practices, behaviors, and attitudes. If the claim that teachers spend little time teaching science, feel unqualified to teach science, or lack science teaching experiences is accurate then it behooves teacher educators to seek ways to improve teachers' self-efficacy beliefs. One possible way of doing this is by providing pre-service teachers with more relevant experiences and modeling of successful teaching (Bandura, 1977; Kazempour, 2014; Putman, 2012; Simsar & Davidson, 2020).

Given the apparent lack of interest by early childhood teachers in teaching science, their negative views toward the subject, and lack of time spent in teaching science, providing quality teacher education is important (Kazempour, 2014; Putman, 2012). Quality teacher education should, in theory, lead to the preparation of highly trained teachers for teaching science. Indeed, the research evidence is clear that the nature and quality of university teacher preparation programs are an influential factor in terms of preservice teachers' self-efficacy beliefs (Avery & Meyer, 2012; McKinon & Lamberts, 2014; Velthuis, Fisser, & Pieters, 2014; Worch, Li, & Herman, 2012). Moreover, it seems that the critical element of university teacher education programs is the provision of practical field experiences. This is because field experiences include elements such as classroom teaching, observations with feedback, and reflective writing regarding instructional events (Putman, 2012), which in combination can provide what can be described as mastery experiences.

Providing the range of experiences in a quality field setting can, however, be challenging. Also, the preservice teachers themselves often struggle with elements of the practical field experience. Hoy (2000), for example, noted that "student teachers (preservice teachers) often underestimate the complexity of the teaching task and their ability to manage many agendas simultaneously" (p.6). This situation is probably why Ashton (1984) suggested that teacher education programs need to provide more training that provides a range of experiences for different situations. To this end it is important that preservice teachers are able to observe a broad range of science teaching so that they can compare the various instances of science teaching. Preservice teachers who have more science teaching experiences, or have observed more science teaching, will be more likely to increase their self-efficacy beliefs about teaching science (Ashton, 1984; Bandura, 1977).

In contrast to previous studies, the current study focused exclusively on elements of the practicum or field experience. This included the mentor teachers' self-efficacy beliefs, their modeling and provision of feedback, as well as the time spent by the preservice teachers observing science teaching as well as teaching science in classroom. Of interest were the separate correlations between these elements and the preservice teachers' science teaching self-efficacy beliefs

Method

Research Design

The current research was a correlational study that was designed to examine the relationship between the variables of interest. Within the literature, there were several related studies that used correlational methods to study

preservice elementary and early childhood teachers' self-efficacy beliefs about teaching science (Avery & Meyer, 2012; Plourde, 2002; Wagler 2011; Yilmaz & Cavas, 2008). Given the nature of the research questions, it was determined that a correlational design would be the most appropriate analytical approach. Creswell (2012) noted that a "correlational study provides an opportunity for you to predict scores and explain the relationship among variables" (p. 338).

The current study examined how factors concerning pre service teachers' teaching experiences are related to their self-efficacy beliefs. The correlational analyses yield several coefficients that range from 0-1. Typically, in correlational research the coefficient (r) is a measure of the linear relationship between two variables. A coefficient that is between .66 and .85 would represent a strong positive relationship: whereas a coefficient of .2 would be a weak positive relationship (Creswell, 2012). In the context of the current study a correlation between preservice early childhood teachers' self-efficacy scores from the STEBI-B and the MEST modeling score of $r=.80$ could be interpreted as a strong positive relationship. It would also mean the scores on the modeling measure could be used to predict preservice teachers' self-efficacy beliefs.

Participants

The study's participants were preservice early childhood teachers selected from undergraduate early childhood education students enrolled at two Turkish universities. Also participating were the undergraduate students' mentor teachers employed in public pre-kindergarten classrooms. The preservice early childhood teachers recruited for the study were undergraduate students in their senior year and final semester of early childhood teacher education programs. The participants included 17 Male (17.7%) and 79 Female (82.3%) senior preservice early childhood teachers ($n=96$) and they had all been placed in several public school classrooms for their practical teaching experiences. A total of (33.3%) were in classrooms for 3- to 4-year-old children and 64 (66.7%) were placed in classrooms for 5-6-year-old children. The preservice teachers' were in the field for 5 to 13 weeks and the average number of practice days for pre-service teachers teaching experiences was 11 days for 11 weeks.

Most of the mentor teachers had worked with preservice teachers for several years. However, a large proportion (46%) had mentored preservice early childhood teachers for fewer than 4 years. All of the mentor teachers provided information concerning the nature and extent of their mentoring practices. A majority of the mentor teachers, 37 teachers (90.2%), reported that they mentored their preservice teacher during classroom science activities, and only 4 (9.8%) indicated they did not provide any mentoring experiences whatsoever when their preservice teachers were in the classroom. Moreover, 33 (80.5%) of the mentor teachers had a science corner/center in their classrooms, while only 8 (19.5%) mentor teachers did not have a science center or corner. Relatedly, most of the mentor teachers felt that they did not have enough science materials in their classrooms.

Procedures

During the semester long practicum the participants recorded the amount of time they were engaged in various

science teaching related activities. Thus, on a weekly basis, the preservice teachers recorded the amount of time they spent observing the mentor teacher teaching science, and the amount of time they themselves spent teaching science. Then, at the conclusion of the field experiences the undergraduate students and their mentors were administered instruments (STEBI-A and STEBI-B) designed to measure their science teaching efficacy beliefs. Finally, the undergraduate students were administered the Mentoring for Effective Science Teaching (MEST) instrument.

Instruments

Several instruments were used in the study including the Science Teaching Efficacy Beliefs Instrument (STEBI-B) for preservice teachers, Science Teaching Efficacy Beliefs Instrument (STEBI-A) for mentor teachers, Mentoring for Effective Science Teaching (MEST), and Science Experiences Time Tracking Record (Time tracker). Since the data were collected in Turkey and all of the participants were Turkish, it was necessary to translate the instruments into Turkish. This was undertaken by one of the researchers and several Turkish colleagues.

Science Teaching Efficacy Beliefs Instrument (STEBI-B)

The STEBI-B is a widely used instrument (e.g., Cone, 2009; Hechter, 2011; Morrel & Carroll, 2003; Plourde, 2002) for measuring pre-service teachers' self-efficacy beliefs about teaching science (STEBI-B) (Enochs & Riggs, 1990). The survey instrument consists of 23 statements to which respondents indicate whether they agree or disagree using a 5-point Likert type scale. The resulting data yield measures of two factors, personal science teaching efficacy (PSTE) science teaching outcome efficacy (STOE). Recent research (Bleicher, 2004) suggests that the instrument's reliability is within an acceptable range (PSTE $\alpha=.87$; STOE $\alpha=.72$). The Turkish version of the STEBI-B had been previously translated into Turkish by Bıkmaz (2002).

Furthermore, the reliability estimate ($\alpha=.85$) of the Turkish version of STEBI-B was judged to be within an acceptable range (Bıkmaz, 2004). For the purposes of the present study, the reliability of STEBI-B was evaluated and a value within an acceptable range was obtained ($\alpha = .70$) (George & Mallery, 2003). A sample item from STEBI-B is "*I will continually find better ways to teach science.*"

Science Teaching Efficacy Beliefs Instrument (STEBI-A)

The STEBI-A (Riggs & Enoch, 1990) was used to measure the mentor teachers' science teaching self-efficacy beliefs. This instrument has also been extensively used by researchers (e.g., McKinnon & Lamberts, 2014; Velthuis, Fisser, & Pieters, 2014). Survey respondents indicate the extent to which they agree or disagree with a series of statements using a 5-point Likert type scale. This instrument yields two factors, including science teaching outcome expectancy (STOE) and science teaching outcome efficacy (STOE).

The reliability estimate for the Turkish version of the STEBI-A ($\alpha=.71$) was also judged to be within an acceptable range (Bıkmaz, 2004). Cronbach alpha score calculated using data from STEBI-A for the current study.

It was found to be low ($\alpha=.57$), but within a reliable range (George & Mallery, 2003). A sample item from STEBI-A is “*I know the steps necessary to teach science concepts effectively.*”

Mentoring for Effective Science Teaching (MEST)

In order to estimate the relationship between the preservice teachers’ perceptions of their mentor teachers’ modeling and feedback and their self-efficacy beliefs, the preservice teachers were administered the Mentoring for Effective Science Teaching (MEST) instrument. The MEST was adapted from the Mentoring for Effective Primary Science Teaching (MEPST) which was developed by Hudson (2007). The survey yields five main factors that evaluate mentoring for effective primary science teaching: personal attributes, system requirements, pedagogical knowledge, modeling, and feedback. The survey consists of 34 items to which respondents indicate their agreement using a 5-point Likert type scale (Strongly Agree, Agree, Uncertain, Disagree, and Strongly Disagree).

Since the original survey (MEPST) was designed for preservice primary science teachers it was slightly modified for use with early childhood preservice teachers. For example, the wording of item 7 was modified so that it referred to early childhood teachers: “had a good rapport with the early childhood students doing science”. The reliability of the English version of the instrument is within an acceptable range, with Cronbach alpha scores for each factor as follows: personal attributes $\alpha=.93$, system requirements $\alpha=.76$, pedagogical knowledge $\alpha=.94$, modeling $\alpha=.95$, and feedback $\alpha=.92$ (Hudson, 2007).

Estimates of the reliability of the Turkish version of the MEST are also within acceptable ranges: personal attributes $\alpha=.94$, system requirements $\alpha=.77$, pedagogical knowledge $\alpha=.91$, modeling $\alpha=.85$, and feedback $\alpha=.79$ (Hudson, Usak, & Savran-Gencer, 2010). In the present study, the reliability of MEST was recalculated: $\alpha=.89$ for personal characteristics, $\alpha=.82$ for system requirements, $\alpha=.93$ for pedagogical knowledge, $\alpha=.90$ for modeling, and $\alpha=.80$ for feedback dimension. Moreover, a high value of Cronbach's alpha value ($\alpha=.97$) was obtained for the Turkish version of MEST. Based on the research questions, only modeling and feedback scores were analyzed in the current study. A sample item from MEST is “*had a good rapport with the early childhood students doing science.*”

Science Experiences Time Tracking Record (Time tracker)

A time tracker was developed by the researcher for collecting data about the amount of time spent on science activities by the mentor teacher and the preservice teachers. The log included two sections that allowed students to record the times spent on different science teaching and observing activities. Preservice early childhood teachers recorded the number of minutes they were engaged in either teaching or observing science. At the end of the teaching practicum, total scores on the observation section was used for the measure of the mentor teachers’ total amount of time spent teaching science and total scores on the teaching/taught section was used for the measure of preservice teachers’ total amount of time spent science teaching.

Results and Discussion

Scores from the STEBI-B and STEBI-A were used to measure the pre-service and mentor teachers' science teaching efficacy beliefs. Descriptive statistics for these measures are reported in Table 1. Then, in Table 2, descriptive statistics for the MEST instrument are reported. In Table 3, preservice teachers' amount of time they observe science teaching and their science teaching in classroom were reported

Table 1. Descriptive Statistics

	<i>N</i>	<i>M</i>	<i>SD</i>	Min	Max
STEBI-B Personal Science Teaching Efficacy	96	35.69	4.91	26.00	50.00
STEBI-B Science Teaching Outcome Expectancy	96	33.46	3.33	25.00	46.00
STEBI-B TOTAL	96	69.16	7.47	51.00	96.00
STEBI-A Personal Science Teaching Efficacy	41	38.58	3.84	32.00	46.00
STEBI-A Science Teaching Outcome Expectancy	41	41.26	5.20	25.00	49.00
STEBI-A TOTAL	41	79.81	6.69	62.00	94.00

Table 2. Descriptive Statistics of Mentoring for Effective Science Teaching (MEST)

	<i>N</i>	<i>M</i>	<i>SD</i>	Min	Max
MEST Modeling	96	25.56	6.37	10.00	39.00
MEST Feedback	96	20.15	5.21	6.00	29.00
MEST TOTAL	96	104.04	24.00	51.00	151.00
Valid N	96				

As reported in Table 3, it is evident that there was considerable variability in terms of the amount of time the preservice teachers spent observing the teaching of science. Similarly, there was variation in the amount of time the pre service teachers spent actually teaching science in the classroom (see Table 3). The results showed that preservice early childhood teachers taught science more than they observed in classroom.

Table 3. Descriptive Statistics for the Time Tracker

	<i>N</i>	<i>M</i>	<i>SD</i>	Min	Max	Range
Observing Time	96	155.26	107.91	.00	390.00	390.00
Teaching Time	96	192.08	67.01	75.00	360.00	285.00
Valid N	96					

The results of the correlational analyses are reported in Table 4. There was a statistically significant correlation between the mentor and preservice teachers' self-efficacy beliefs. There was also a statistically significant correlation between the time spent teaching science and the preservice teachers' self-efficacy. Also, correlated with the preservice teachers' self-efficacy beliefs were the measures of mentor teachers' modeling and feedback. The correlations uncovered in this study suggest that if preservice teachers are given an opportunity to see the outcomes of their teaching, and receive constructive feedback from their mentor teachers, they will be most likely

have more confidence in their teaching, and thereby increase their self-efficacy beliefs.

Table 4. Correlation between Variables Related to Preservice Teachers' Science Teaching Efficacy

	STEBI-B	STEBI-A	Modeling	Feedback	Observation	Teaching
STEBI-B		.42*	.58*	.50*	.10	.85*
STEBI-A			.32*	.21*	-.19	.38*
MEST Modeling				.64*	.11	.57*
MEST Feedback					.21*	.50*
Observation						.14
Teaching						

* Correlation is significant at the .05 level (2-tailed).

The findings suggest that mentor teachers play an important role in the preparation of preservice teachers, and that this role is particularly true for those mentors with higher science teaching self-efficacy beliefs. In addition, the results showed that one of the main factors influencing preservice teachers' science teaching self-efficacy was their actual experiences in teaching science during their classroom-based field experience, or practicum. This finding was not unexpected since it is well established that mastery experiences constitute a major source of an individual's self-efficacy (Bandura, 1977). In contrast, however, simply observing someone's teaching science did not seem to be effect to preservice teachers' self-efficacy beliefs. It seems that, in terms of potentially shaping preservice teachers' self-efficacy beliefs, observing classroom teaching is not enough. The findings suggest that what is important is providing the preservice teachers with regular opportunities to teach science. Likewise, the results showed that mentor teachers' modeling and feedback about science teaching in classroom had significant correlation with preservice early childhood teachers' science teaching self-efficacy beliefs.

Relationships with Spend Teaching Science and Preservice Early Childhood Teachers' Science Teaching Self-Efficacy Beliefs

In the current study, it is found that spending more time on teaching science and preservice early childhood teachers' science teaching self-efficacy belief are statistically significant. Bandura (1997), in his now classic work, noted the significance of teaching experiences as one of the essential sources of teachers' self-efficacy beliefs. Within the current study, the correlational analyses suggested that the amount of time that preservice teachers spent teaching science in the classroom was related to their science teaching efficacy beliefs. The importance of teaching has been addressed by several researchers, presumably because it affects preservice teachers' science teaching outcome expectancy (Cantrell et al., 2003; Plourde, 2002). Their observations, along with the data reported here provide evidence that classroom teaching experience (i.e., time spent teaching science) is a key source of influence of preservice teachers' self-efficacy beliefs. Yet, beyond the current study, the empirical evidence concerning teaching time and its correlation with preservice teacher's science teaching efficacy beliefs, is limited. Probably the most extensive research was conducted by Velthuis et al. (2014) who found that there were statistically significant differences between preservice teachers' PSTE scores and the frequency of their science teaching (Velthuis et al., 2014). Yet, the researchers did not examine the correlation between the

actual amount of time spent teaching and the preservice teachers' self-efficacy. Instead, they simply examined the frequency of science teaching. In other words, how often, but not how long, the preservice teachers taught science. In contrast, Cantrell et al. (2003) examined the relationship between the actual time spent teaching and self-efficacy beliefs. Here, the researchers found that preservice teachers who had more than 3 hours of science teaching during their 3 weeks' practicum had the largest increases in their PSTE scores (Cantrell et al., 2003). This suggests that the optimal time for science teaching by preservice teachers could be approximately 60 minutes per week; at least to the extent that there is the related expectation of positively influencing preservice teachers' self-efficacy beliefs.

The current study's findings seem to be consistent with those of Cantrell et al. (2003) and Simsar and Davidson (2020) in that the total amount of time spent teaching science was related to preservice teachers' science teaching self-efficacy beliefs. In this case the data revealed that on average the preservice teachers engaged in 192 minutes of teaching during their 10-12 weeklong practicums. When compared to Cantrell et al.'s (2003) study, this is not a particularly lengthy teaching experience. Yet, when considered alongside findings from other studies such as those by Bleicher and Lindgren (2005) and Simsar and Dogan (2020), the correlation between time spent teaching and self-efficacy beliefs is plausible.

Relationships with Mentor Teachers Modeling and Preservice Early Childhood Teachers' Science Teaching Self-Efficacy Beliefs

The current study found that mentor teachers science teaching modeling behavior is one of the essential factors that influence their preservice teachers' science teaching self-efficacy beliefs. The correlation between mentor teachers' modeling and preservice teachers' science teaching self-efficacy beliefs was evaluated based on the preservice teachers' perspectives of their mentor teachers' modeling behavior. One interpretation of this finding is that by appropriately modeling during the field experience the mentor teachers provide opportunities for their preservice teachers to improve their teaching skills, and in turn, their self-efficacy beliefs. Furthermore, for the purposes of the current study, modeling was not considered simply as teaching a science lesson and allowing the preservice teacher to observe. In this case it included the modeling of lesson planning, appropriate use of science language, effective science teaching, appropriate use of hands-on science activities, and using well designed science activities. While it is true that modeling includes an element of observation, it can be more appropriately interpreted as purposefully exhibiting quality teaching and related activities. Thus, it seems that as a purposeful activity, modeling by the classroom teacher in the context of science teaching and learning could be effective in shaping pre-service teachers' self-efficacy beliefs.

Carrol (2005) and Simsar and Dogan (2019) works drew attention to the importance of mentoring by experienced teachers by noting that experienced teachers should be willing role models for preservice teachers through encouragement and support during the teaching practicum. The current study's findings showed that most mentor teachers were relatively experienced, and as such should be able to be good role models for preservice teachers. Most of the mentor teachers had previously mentored preservice teachers. Furthermore, most of the preservice teachers gave their mentor teachers high scores for their modeling behaviors by rating items such as "Had

well-designed science activities for the students.” This suggests that the preservice teachers paid attention to their mentor teachers’ well-designed science activities, which in turn could have impacted their self-efficacy beliefs about teaching science. In addition, the preservice teacher’s ratings on the MEST instrument suggest that mentor teachers’ modeling is not simply a matter of exhibiting a behavior. It also means that the modelled behavior supports preservice teachers based on their perspectives and expectation concerning science teaching. Furthermore, it suggests that a mentor teacher’s modeling behaviors differ in subtle ways from simply showing or displaying that behavior. Thus, in the current study, there was a correlation between modeling by the mentor and preservice teachers’ self-efficacy beliefs, whereas there was no relationship between this construct and the amount of time spent simply observing. Similar results also highlighted by Simsar and Davidson (2020) as mentor teachers’ science teaching methods and giving time to science impacts preservice teachers’ attitudes towards science and science teaching in the early childhood classroom. Moreover, El Takach and Yacoubian (2020) stated that teachers stereotypical images or views about science and science subjects could impacts their students attitudes towards science and future science majors. In this case, it is an important position that teachers should be role models in science teaching in their classroom.

Relationships with Feedback and Preservice Early Childhood Teachers’ Science Teaching Self-Efficacy Beliefs

The analyses found that there was a significant correlation between the mentor teachers’ feedback and the preservice teachers’ science teaching self-efficacy beliefs. This suggests that receiving feedback from mentor teachers could help improve preservice teachers’ science teaching self-efficacy beliefs. As theorized by Bandura (1977), verbal persuasion (mentor teacher’s feedback) is one of the main sources of self-efficacy beliefs. In the present study, feedback was considered a critically important role of mentor teachers (Murray et al., 2011). Although verbal persuasion, or feedback, is a critical source of self-efficacy (Bandura, 1977), few studies have identified a relationship between preservice teacher’s science teaching self-efficacy beliefs and their mentor teacher’s feedback (Andrew & Quinn, 2005; Hudson, 2007; Hudson et al., 2009; Ngoepe, 2014; Putman, 2012; Simsar & Davidson, 2020; Smith & Ingersoll, 2004). In a recent study, Putman (2012) noted that receiving supportive feedback from mentor teachers had a positive influence on the self-efficacy beliefs of preservice teachers during their student teaching. Similarly, researchers concluded that preservice teachers expected their mentors to emotionally and professionally support them so as to increase their confidence in teaching (Simsar & Davidson, 2020). Moreover, Simsar and Davidson (2020) highlighted that social persuasion, which is about positive encouragement, has more positive influence on preservice teachers’ science teaching self-efficacy when it compared with other sources of self-efficacy beliefs (such as mastery experiences, vicarious experiences, and physiological and emotional states).

The current study’s findings seem to validate researchers’ recent position concerning the importance of feedback: “without adequate mentoring and guidance, the professional development of preservice teachers may not be maximized during these crucial real world learning experiences” (Murray et al., 2011, p.1). Likewise, the preservice participants in this study indicated that their mentor teachers clearly communicated what the preservice teachers needed to do to improve their science-teaching skills. Possibly, the provision of support in the

form of regular verbal or written feedback concerning the preservice teachers' teaching performance influenced their self-efficacy beliefs about their science teaching. This being the case then, as a mentoring strategy, the provision of feedback should be encouraged.

Relationships with Mentor Teachers' Self-Efficacy Beliefs and Preservice Early Childhood Teachers' Science Teaching Self-Efficacy Beliefs

The research literature on this topic has mostly focused on teachers' self-efficacy and its impact on their students' achievement and motivation (Palmer, 2006; Putman, 2012). That is, researchers have been interested in examining the role of self-efficacy in shaping classroom instruction and, relatedly, children's achievement and motivation. While focusing on the classroom teachers' self-efficacy beliefs, the current study adopted a different approach by exploring the possibility that this construct also influences preservice teachers' development. In this case the findings suggest that the classroom teachers' beliefs are a source of influence on preservice teachers' self-efficacy beliefs. The results suggest that there was a moderate, yet statistically significant correlation between the mentor teachers' and preservice teachers' science teaching self-efficacy beliefs. One explanation for this finding is that the teachers with high self-efficacy beliefs engaged in behaviors and activities that positively influenced the pre-service teachers in ways that enhanced their self-efficacy. Caution, however, should be exercised in interpreting this correlation. After all, correlation does not imply causation, and, at best, specifying the source and direction of influence can only be speculative. Yet, by drawing on the relevant theoretical background and recent research findings, some tentative explanations can be considered.

The finding of a moderate correlation between the teacher and preservice teachers' self-efficacy beliefs is consistent with Bandura's (1977) position maintaining that if an observer understands the behavior that is being modeled in a task, the observer can improve his or her own skills on that behavior in that task. There are, however, other factors that could impact the model's behavior, such as self-efficacy in relation to a particular task. Tschannen-Moran and colleagues (2007) defined self-efficacy as a teacher's belief in his or her ability to influence students' performance on a particular task. Researchers also noted that teachers' self-efficacy consists of a belief in their own ability to increase their students' learning and behaviors (Putman, 2012). Theoretically, if mentor teachers' beliefs influence their own behaviors on a task, then their preservice teacher mentees might also be affected based on their mentor teachers' modeling behaviors. For example, this could include aspects such as preservice teachers' having opportunities to observe those behaviors, receiving productive feedback about the task, and being allowed to demonstrate the behavior in the classroom. Similarly, Simsar and Davidson (2020) stated in their study on the sources of science teaching self-efficacy beliefs of prospective teachers that mentor teachers' attitudes towards science and science teaching competencies may have a positive effect on preservice teachers' self-efficacy.

While the findings suggest that there is a moderate relationship between the pre-service and mentors' self-efficacy beliefs, it is possible that other factors could have impacted the current results regarding this correlation. For example, relevant elements here could include the mentor teachers' attitudes toward science teaching, how often the mentor teachers taught science, the preservice teachers' attentiveness when their mentor teachers

taught science, the extent to which the preservice teachers understood the connection between what the mentor teachers taught and students' learning, and the frequency and duration of the preservice teachers' practicum. Besides, in a recent study, El Takach and Al Tobi (2021) stated that most of the students dislike science because of their background experiences about teaching and assessing their learning by their teachers. This could be another factor that affects preservice teachers' science teaching self-efficacy (Simsar & Davidson, 2020).

Relationships with Observation Time in Teaching Science and Preservice Early Childhood Teachers' Science Teaching Self-Efficacy Beliefs

Bandura (1977) suggested that informing observers about the benefits of modeled behavior could have more of an effect when observers learn those behaviors. It follows that if mentor teachers show how materials and supplies can be used in science teaching and learning, demonstrate appropriate classroom management skills in science activities, and show how preservice teachers can gain access to scientific sources (such as books, journals, websites, etc.), then these observational behaviors may help to improve preservice teachers' understanding of how they can teach science in their future teaching positions. Such activities, along with Bandura's (1977) position, suggest that there is communicative component of modeling and observation. Preservice teachers are placed in classrooms for field experiences so that they can both observe and engage in classroom teaching. According to Moody (2009) preservice teachers usually want to observe their mentors' teaching so that they can determine and adopt their own teaching style. The assumption is that when classroom teachers demonstrate how science can be taught in early childhood classrooms, the preservice teachers who observe the lesson will most likely improve in the way they teach science. This was evident in Tschannen-Moran et al.'s (1998) study that identified a correlation between observers' efficacy beliefs and models' performance based on the observation. The researchers stated that if a model performs well in a related task, the self-efficacy beliefs of the observer are enhanced. However, the observer's self-efficacy level could also decrease after observing a mentor teacher's poor or inadequate performance (Tschannen-Moran et al., 2007). Likewise, Preuss et al. (2020) highlighted the giving more time to for modeling could be very essential for preservice teachers. Researchers concluded that preservice teachers could be improve their learning related with subjects when they have more observation time for how they can handle about topic (Preuss et al., 2020).

Such findings point to the important influence that observation can have on a preservice teacher's self-efficacy beliefs. In the current study, preservice teachers were given opportunities to observe their mentor teachers teaching science. Yet, surprisingly, the analyses did not yield any significant correlation between the time the preservice teachers spent observing and their self-efficacy beliefs. There are several possible reasons for this seemingly perplexing finding. One is the simple fact that the preservice teachers, in this case, did not have sufficient time observing in the classroom. A second plausible reason is that observation in and of itself may not be effective in influencing preservice teachers' self-efficacy. This possibility is supported by the fact that there was a positive correlation between modeling and the preservice teachers' self-efficacy beliefs.

Overall, the findings suggest that the experiences associated with preservice teachers' field experiences are related to their self-efficacy beliefs. Given the associations, evident in these findings, between self-efficacy

beliefs and the mentoring components of modeling, feedback, and teaching experiences, then the importance of the practicum could rest on the overall quality of the experience in terms of the mentoring. This, coupled with the lack of association between observation time and self-efficacy beliefs, suggests that simply observing in a classroom may not be enough. Observation with a purpose by way of targeted modeling by a mentor teacher who provides constructive feedback could be a strategic approach that leads to improved science teaching in early childhood classrooms.

Conclusion

In conclusion, it is well established that preservice teachers often have a difficult time selecting appropriate inquiry activities during their science teaching experiences. The correlations uncovered in this study suggest that if preservice teachers have an opportunity to see the outcomes of their teaching, and receive constructive feedback from their mentor teachers, they will probably have more confidence in their teaching, and thereby increase their self-efficacy beliefs. Moreover, the findings point to the important role of the mentor teacher during early childhood pre-service teachers' field experiences.

Future research should explore the types of modeling and/or feedback that correlates with preservice teachers' science teaching self-efficacy beliefs. To this end, qualitative approaches could lead to more in depth understanding of the specific aspects of modeling that may be effective. More in depth studies should also be conducted to focus more exclusively on ways in which the provision of feedback supports or hinders a preservice teacher's growth as an effective science teacher. While quantitative correlational studies can uncover potential associations, their usefulness is limited in that they cannot reveal the nuances and complexities of teachers' modeling behaviors.

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