European Journal of Education Studies
ISSN: 2501 - 1111
ISSN-L: 2501 - 1111
Available on-line at: www.oapub.org/edu

doi: 10.5281/zenodo.2527062 Volume 5 | Issue 8 | 2018

EFFECTS OF FIELD EXPERIENCE AND TEACHING PRACTICE ON PROSPECTIVE SCIENCE TEACHERS' SELF-EFFICACY BELIEFS

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Abstract:
The main purposes of this study were to investigate if there were any effects of field experience and teaching practice on prospective science teachers' self-efficacy beliefs and identify possible factors that may affect their self-efficacy beliefs. Participants were forty students consecutively enrolled in field experience and teaching practice at the final year of science teacher education program. Data were collected from two main sources: the Science Teaching Efficacy Beliefs Instrument-Pre-service ([STEBI-B], Belicher, 2004; Tekkaya, Cakiroglu, & Ozkan, 2004) and semi-structured interviews. The instrument was administered at three different times during the field experience and teaching practice. Thirteen of the participants were interviewed at the three times the instruments were collected. Findings indicated that there were no significant differences on prospective science teachers' self-efficacy beliefs during field experience and teaching practice. Participants felt that they had lack of content knowledge and teaching practice. This study has significant implications for science teacher educators.

Keywords: self-efficacy beliefs; science teaching; teaching practice; field experience; student teaching; prospective science teachers

1. Introduction

Studies on self-efficacy have received attention by the education community for several decades (Zee & Koomen, 2016). Bandura (1977) firstly introduced self-efficacy and defined as "*a person's belief in his/her ability to perform a difficult task*" (Bandura, 1982; 1986). According to Bandura (1977), self-efficacy consisted of two dimensions; personal self-efficacy and outcome expectancy. The former was defined as "*the conviction that one can successfully execute the behavior required to produce the outcomes*" (1977, p.79), and the

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latter was defined as "*a person's estimate that a given behavior will lead to certain outcomes*" (1977, p.79). Bandura (1986; 1997) suggested four sources that influence self-efficacy as performance accomplishment, vicarious experiences, social persuasion, and emotional arousal. Performance accomplishment is the most powerful source deriving from personal practical experience. Vicarious experience involves a person observing another's performance. Verbal persuasion from others can influence our self-efficacy either positively or negatively. The final source is the emotional arousal affecting self-efficacy beliefs either positively or negatively.

Teacher education programs provide prospective teachers with opportunities to gain knowledge and experience. Field experience and teaching practice are indispensable components of teacher education programs since they build a bridge between theory and practice. In this article, field experience means the initial field course where prospective teachers just spend observing in a science classroom while teaching practice means a specific field experience where prospective teachers observe another's practice and begin teaching science in real classroom setting. Field experience and teaching practice provide prospective teachers with mastery and vicarious experiences, accepted to be main sources of self-efficacy (Bandura, 1997). Therefore, this study was conducted in order to investigate if there were any effect of field experience and teaching practice offered at the final year of teacher education program on prospective science teachers' self-efficacy beliefs and to identify reasons why their self-efficacy beliefs changed or did not change during these periods.

2. Literature Review

Self-efficacy beliefs was proposed as the most influential beliefs in people's everyday lives (Bandura, 1982; 1986) and accepted to be a powerful predictor of performance (Palmer, 2006a). People who have higher efficacy for a particular task are more likely to perform persistent efforts until they succeed while people who have lower efficacy are more likely to give up after minimal effort (Huinker & Madison, 1997; Palmer, 2006a). Teacher efficacy beliefs may predict their future teaching success and may positively influence students' achievement in science (Bandura, 1997; Cantrell, Young, & Moore, 2003). Therefore, a considerable amount of research has focused on how to increase pre-service teachers' beliefs of self-efficacy during teacher education programs (Bayraktar, 2011).

In the literature, scholars have examined the changes of self-efficacy beliefs in terms of several aspects: (a) during science methods courses (Brand & Wilkins, 2007; Bleicher, 2007; Gunning & Mensah, 2011; Hechter, 2011; Huinker & Madison, 1997; Kazempour & Sadler, 2015; Palmer, 2006a; 2006b; Weinburgh, 2007), (b) science laboratory courses (Savasci-Acikalin, 2014), (c) during student teaching (Brown, Lee, & Collins, 2015; Cantrell, Young, & Moore, 2003; Martins, Costa, & Onofre, 2015; Plourde, 2002), (d) during microteaching practices (Arsal, 2014; Mergler & Tangen, 2010), (e) during the beginning of their teaching experiences (Ginns & Watters, 1999; Mulholland & Wallace, 2001; Woolfolk Hoy & Burke Spero, 2005), (f) during teacher education

programs (Petersen & Treagust, 2014; Velthuis, Fisser, & Pieters, 2014), (g) in-service activities (Eshach, 2003; Posnanki, 2002; Roberts, Henson, Tharp, & Moreno, 2001), (h) informal education institutions such as science centers (McKinnon & Lamberts, 2014), (i) demographic variables such as gender, prior science experiences, grade levels, cultural context (Aydin & Boz, 2010; Bursal, 2010; Bayraktar, 2011; Cakiroglu, Cakiroglu, & Boone, 2005; Lin & Gorrell, 2001; Mulholland, Dorman, & Odgers, 2004), and (j) the relationship with some factors such as science understandings levels (Schoon & Boone, 1998; Tekkaya, Cakiroglu, & Ozkan, 2004), classroom management (Savran & Cakiroglu, 2003; Savran-Gencer & Cakiroglu, 2007; Yilmaz & Huyuguzel-Cavas, 2008), teacher burnout (Skaalvik & Skaalvik, 2010), teacher concerns (Boz & Boz, 2010), teacher intention to quit (Pfitzner-Eden, 2016) and student achievements (Angle & Moseley, 2009).

Although studies on self-efficacy regarding a variety of issues have been widely reported in the literature as discussed in the previous paragraph, there is relatively little research focusing on merely the influence of field experiences on pre-service teachers' self-efficacy beliefs (Cantrell, Young, & Moore, 2003; McDonnough & Matkins, 2010; Plourde, 2002; Yilmaz & Huyuguzel-Cavas, 2008). Studies on the influence of field experience on pre-service teachers' self-efficacy beliefs have found inconsistent results. Uludağ-Bautista (2011) studied with forty-four pre-service elementary teachers taking a science methods course that focused exclusively on providing various mastery and vicarious experiences. In her study, she found that personal science teaching efficacy beliefs and science teaching outcome expectancy beliefs significantly over the semester. McDonnough and Matkins (2010) compared the effects of variations in field experiences at two institutions, on which included a practicum that was not connected to the science methods course and instructor and the other where the practicum was concurrent with and taught by the methods instructor. They found that the concurrent, embedded practicum yielded consistent increases self-efficacy across the semesters.

Cantrell, Young, and Moore (2003) examined pre-service elementary teachers' efficacy beliefs at three different stages of their teacher education program: (a) during the introductory methods seminar courses, (b) during advanced methods courses, and (c) during the student teaching. Plourde (2002) investigated the influence of student teaching on pre-service elementary teachers' science self-efficacy and outcome expectancy beliefs. Both studies found very little correlation at all between experience and teaching efficacy beliefs.

There have been some studies comparing pre-service teachers' self-efficacy beliefs across grade levels. Aydın & Boz (2010) administered the STEBI-B to 492 pre-service elementary science teachers studying at different grades in order to investigate participants' self-efficacy beliefs. The authors found that senior students' self-efficacy beliefs had significantly higher scores than those of freshmen, sophomores, and juniors and they attributed this difference to the teaching practice offered in the final year of the teacher education programs. Bayraktar (2011) made a comparison between freshmen' and seniors' self-efficacy beliefs by using the STEBI-B and found that pre-service primary teachers' PSTE beliefs developed through teacher training period but their

STOE beliefs did not change during their education in the program. However, it is hard to attribute the findings of both studies to teaching practice since neither of them focused on only the effect of teaching practice. Yilmaz and Huyuguzel-Cavas (2008) conducted a study in order to investigate the effect of teaching practice on pre-service elementary teachers' self-efficacy beliefs and found that teaching experience did not affect pre-service elementary teachers' science teaching efficacy beliefs. Moreover, many of these studies focused on elementary pre-service teachers' self-efficacy beliefs and used only one data source, the STEBI-B (Bayraktar, 2011; Cantrell, Young, & Moore, 2003; Plourde, 2002; Yilmaz & Huyuguzel-Cavas, 2008). There is a need to investigate the effect of teaching practice on prospective science teachers' self-efficacy beliefs of science teaching from a variety of data sources including quantitative and qualitative data for a long time period. This study intends to fill this gap and make contribution to the literature.

3. Research Questions

The purpose of the study were to investigate if there is any effect of field experience and teaching practice taken at the final year of teacher education program on prospective teachers' self-efficacy beliefs and identify reasons why their self-efficacy beliefs changed or did not change. Therefore, the present study was guided by the following research questions:

1. Is there any significant difference of prospective science teachers' self-efficacy beliefs before and after field experience? If yes, why or why not?
    a. Is there any significant difference of prospective science teachers' personal teaching efficacy beliefs before and after field experiences?
    b. Is there any significant difference of prospective science teachers' outcome expectancy beliefs before and after field experiences?
2. Is there any significant difference of prospective science teachers' self-efficacy beliefs before and after teaching practice? If yes, why or why not?
    a. Is there any significant difference of prospective science teachers' personal teaching efficacy beliefs before and after teaching practice?
    b. Is there any significant difference of prospective science teachers' outcome expectancy beliefs before and after teaching practice?
3. Is there any significant difference of prospective science teachers' self-efficacy beliefs before field experience and after teaching practice? If yes, why or why not?
    a. Is there any significant difference of prospective science teachers' personal teaching efficacy beliefs before field experiences and after teaching practice?
    b. Is there any significant difference of prospective science teachers' outcome expectancy beliefs before field experiences and after teaching practice?

4. Material and Methods

This study was conducted with prospective teachers enrolled in field experience in fall semester and teaching practice in spring semester in a large northwestern university of Turkey. Students in teacher education programs are selected and placed based upon their scores in a nation-wide exam, administered by the Student Selection and Placement Centre (OSYM), which was affiliated to the Council of Higher Education. Therefore, participants in this study came from different parts of Turkey. All teacher education programs in Turkey are designed by the Council of Higher Education. Thus, the curricula of each program are common for all universities. Field experience is a three-credit hour course offered in fall semesters at the final year of the science teacher education program. Each week students taking field experience are required to attend one hour seminar course at their department and observe four hours science classrooms in middle schools. Teaching practice is a five-credit hour course offered in spring semesters at the final year of science teacher education program. Students are supposed to attend two hours seminars at their department and also attend six hours in middle schools for observation and teaching practice. Field experience and teaching practice courses were selected for the study since they provide prospective teachers with opportunities to observe and teach science classrooms in middle schools and to provide them with mastery and vicarious experiences (Bandura, 1997). In addition, field experience and teaching practice are major components of teacher education programs since they build a bridge between theory and practice.

Forty prospective science teachers, consecutively enrolled in field experience and teaching practice in their final year of teacher education program were voluntarily participated in the study. This study was conducted in a large northwestern university in Turkey. Twenty six (65%) of the participants were female and fourteen of them (35%) were male. Thirteen of the participants were randomly selected for interviews. Pseudonymous names were used in order to provide confidentiality.

The study collected both quantitative and qualitative data. One advantage of this type of design is that the validity of results can be strengthened through triangulation of findings from different data sources. First, the Science Teaching Efficacy Beliefs Instrument-Pre-service (STEBI-B) was given to all participants at three different times; pre- (before the field experience), mid- (after the field experience and before the teaching practice), and finally post- (after the teaching practice). The STEBI-B consisted of 23 items in a five-point Likert-type scale ranging from strongly agree to strongly disagree and has two subscales: personal science teaching efficacy (PSTE), including 13 items and science teaching outcome expectancy (STOE), including 10 items (Bleicher, 2004). Tekkaya, Cakiroglu, & Ozkan (2004) translated the Science Teaching Efficacy Beliefs Instrument-Pre-service (STEBI-B) into Turkish and calculated reliability coefficients as .86 and .79 for personal science teaching efficacy (PSTE) and science teaching outcome expectancy (STOE), respectively. In the current study, reliability coefficients were calculated as .85 and .78 for PSTE and STOE, respectively. A Cronbach's alpha score greater than .70 is considered acceptable for internal reliability

(Hair, Anderson, Tatham, & Black, 1995). Second, thirteen of the participants were randomly selected and invited for semi-structured interviews at the same times when the instruments collected. Interview questions included ten questions regarding prospective teachers' self-efficacy beliefs of teaching science. Each interview took approximately 20 minutes. All interviews were recorded and transcribed for data analysis.

A repeated measures t test was calculated using SPSS 16.0 program in order to response research questions. An inductive approach was used to analyze qualitative data coming from the interviews. Interviews from the thirteen of the participants were examined to answer if there were any change their self-efficacy beliefs and possible reasons for any change -or not- throughout their field experience and teaching practice.

5. Results and Discussion

A repeated measures t-test was calculated using SPSS 16.0 program in order to response the first research question investigating if there was any significant difference of prospective science teachers' scores on STEBI before and after field experiences. Table 1 shows the result of the repeated measures t-test score. Table 1 indicates that there is no significant difference on pre- and post-scores of STEBI, PTSE, and STOE.

Table 1: Prospective science teachers' self-efficacy beliefs before and after field experience

		N	M	SS	t test		
					t	df	p
STEBI	Pre-	40	87.10	7.39	.233	39	.817
	Post-	40	86.83	8.05			
PTSE	Pre-	40	51.13	6.01	.337	39	.738
	Post-	40	50.88	6.02			
STOE	Pre-	40	35.98	4.00	.032	39	.975
	Post-	40	35.95	4.82			

Data from the interview questions confirmed this finding that students did not think their self-efficacy beliefs changed during field experience. Six of the participants interviewed before field experience felt that they are efficient in teaching science while seven of them did not think they were efficient enough to teach science efficiently. After having field experience, the numbers of students who thought themselves as efficacious did not change. Melek stated that field experience had positive effect on her self-efficacy beliefs about teaching science as the following quotation.

> "*What I realized was how inexperience I was. Although I find myself above the average in terms of knowledge and teaching methods, experience is also very important. My mentor teacher has been teaching for a long time and she is not good at some points but she is good at communication with students and classroom management and so on. I realized there are so many things important in teaching.*"

Aylin stated that "*I saw the class and how a class can be. In short my experiences increased with the observation I made."* Figen also agreed with that field experience made her self-efficacy beliefs increases. She stated as follows: "*I observed a lot. While I was observing, I always compared my mentor teachers with myself. I was doing thinking like If I were him, what I would do, or why he have done like that, and what he should have done, thing like that."*

On the other hand, seven of the participants indicated that field experience did not influence on their self-efficacy beliefs of teaching science. The main reason why prospective teachers' self-efficacy beliefs did not change could be lack of personal teaching experience. Although the participants went to observe science classrooms in middle schools, neither they had an opportunity to teach science by themselves not they had a responsibility for one class by themselves. They just observed their mentor teachers' practice. Ali said that "*I did not change at all since I did not do anything other than sitting at the last desk and watching the teacher and the kids*." Didem expressed her views about field experience as follows: "*I wish we did teaching this semester. One semester is over but we just did observation we did not have any teaching experience. I do not believe next three months will be enough for teaching practice I think that we need more practice*"

Similarly, Ceren said that "*there is no change so far. We keep only observing and we cannot make any conclusion by just watching. If we were teaching, then we would have gained some experience and may be a change but now just trying to develop a good model of teacher in my head.*"

A repeated measure t-test was calculated to response the second research question investigating if there was any significant difference of prospective science teachers' scores on STEBI before and after teaching practice. Table 2 shows the result of the repeated measures t-test score. Table 2 indicates that there is no significant difference on pre- and post-scores of STEBI, PTSE, and STOE.

Table 2: Prospective science teachers' self-efficacy beliefs before and after teaching practice

		N	M	SS	t test		
					t	df	p
STEBI	Pre-	40	86.82	8.05	-.516	39	.609
	Post-	40	87.68	9.34			
PTSE	Pre-	40	50.88	6.018	-.870	39	.390
	Post-	40	51.82	6.717			
STOE	Pre-	40	35.95	4.82	.126	39	.900
	Post-	40	35.85	5.04			

Data from the interview questions confirmed this finding that students did not think their self-efficacy beliefs changed during teaching practice. In interviews, except Ceren, all of the participants indicated that they could not find any opportunity to teach science. Ceren had an opportunity to teach science only for one class hour. She indicated that she found herself as an efficacious teacher neither before nor after her teaching experience. The finding was not surprising since participants did not have any

experience or they had little experience to change their self-efficacy beliefs of teaching science.

A repeated measure t test was calculated to response the third research question investigating if there was any significant difference of prospective science teachers' scores on STEBI before field experience and after teaching practice. Table 3 shows the result of the repeated measures t-test score. Table 3 indicates that there is no significant difference on pre- and post-scores of STEBI, PTSE, and STOE. Data from the interviews confirmed this finding that participants did not think their self-efficacy beliefs change in a nine-month period including field experience and teaching practice.

Table 3: Prospective science teachers' self-efficacy beliefs before field experience and after teaching practice

		N	M	SS	t test		
					T	df	p
STEBI	Pre-	40	87.10	7.39	-.420	39	.677
	Post-	40	87.68	9.34			
PTSE	Pre-	40	51.12	6.01	-.746	39	.460
	Post-	40	51.82	6.72			
STOE	Pre-	40	35.98	3.997	.143	39	.887
	Post-	40	35.85	5.041			

Data from the interviews indicated that prospective teachers did not think they had enough content knowledge. Only three participants thought that their content knowledge was enough to teach science. Others participants believed that they did not have enough content knowledge and needed to study before teaching. During field experience and teaching practice prospective teachers found themselves more efficacious in pedagogical content knowledge (having activities, experiments, etc.) and less efficacious in content knowledge (especially topics in physics). For example, at the end of the final year, Lale said that "*I am still not good at physics but I am ok with chemistry and biology*." She added, "*I had been thinking that I was not good at lecturing before I gave a course to a few kids this semester outside the school and I saw I am better at speaking and lecturing*." In a similar way, Ceren expressed her concern about her content knowledge with the following quotations. "*I do not believe I had enough content knowledge to teach science but I hope I will get when I start teaching by studying*". Ceren added that she was good at designing and doing science activities but not good at lecturing due to her lack of content knowledge.

6. Recommendations

The findings of the study offer significant insights related to the literature about self-efficacy beliefs and the teacher education programs. The main findings of the study indicated that field experience and teaching practice was not able to change prospective science teachers' self-efficacy beliefs. Therefore, field experience and teaching practice should be examined in depth. In order to increase the quality of teaching experience,

there might be some factors considered. First of all, selection of schools and mentor teachers are very important. School and mentor teachers provide an environment in which prospective teachers feel themselves as a part of the community. The collaboration between mentor teachers and the instructors at universities should be increased and mentor teachers should be provided with courses and seminars in which they learn how to support and guide prospective teachers. The number of prospective teachers for each mentor teachers and course instructors should be decreased so that mentor teachers and instructors can be more efficiently guide. Second, the length of teaching experience should be increased so that prospective teachers should have experience in different schools and study with different mentor teachers in order to gain multiple points of views. Moreover, some courses such as teaching methods and classroom management courses should be integrated with teaching experience as a part of the course. Therefore, prospective teachers get feedback about their experience from the course instructors.

Another significant finding of the present study was the lack of content knowledge that the prospective teachers always indicated throughout the study. Teacher education programs should provide prospective teachers with an opportunity to have scientific understandings of concepts and to know how to teach science to students in schools. The collaboration between science and education faculties and mentor teachers should be provided in order to prepare better prospective teachers to their professional experiences in near future.

The findings of this study are limited with forty students at one institution. Therefore, more research could be conducted in order to investigate a larger number of participants at more institutions. Moreover, as a further research, a variety of teaching experiences can be compared to investigate their effects on prospective teachers' self-efficacy beliefs. Finally, a longitudinal study may be conducted in order to follow up prospective science teachers' beliefs of teaching science from their teacher education to the beginning of their experiences in schools as in-service teachers.

7. Conclusion

The purpose of this study was to investigate prospective science teachers' self-efficacy beliefs of teaching science during field experience and teaching practice. The main finding of the study indicated that prospective teachers did not think that field experience and teaching practice changed their self-efficacy beliefs of teaching science since they have little teaching experience or did not have any real experience at all. This finding is consistent with Cantrell, Young, and Moore's study (2003) and Plourde's (2002) study indicating that very little correlation between experience and self-efficacy beliefs. Similarly, Yılmaz and Huyugüzel-Çavaş (2008) found that prospective elementary teachers' beliefs did not change by teaching practice. The finding of the present study is different from the other studies indicating positive correlation between teaching practice and self-efficacy beliefs (e.g. McDonnough & Matkins, 2010; Uludağ-Bautista, 2011).

The findings of the present study should be vigilantly interpreted. There may be some factors that affecting the results. The first important factor could be the quality of teaching experience. Although teaching experience is used as a general term indicating student teaching practice in schools, the nature and the length of these experiences may be varied in studies. For example, McDonnough and Matkins study's indicated the concurrent, embedded practicum increased student teachers' self-efficacy beliefs while the practicum independent from methods course and methods instructor did not make any change. The nature of teaching experience should be clearly explained in order to interpret the findings of research studied in the literature. As indicated by Koc (2012), pre-service teachers were not exposed to supportive environment in their professional development. In this study, although pre-service teachers have an opportunity to observe science classrooms, they do not have enough teaching experience and feedback from mentor teachers and their instructors. The second factor could be the quality of mentor teachers. In Turkey, mentor teachers are not selected based on their performance since their schools are selected based on availability of prospective teachers. Every mentor teachers in schools must have at least six prospective teachers in order to get paid for this duty. Therefore, mentor teachers are having difficulty to manage all of the prospective teachers due to the large number of prospective teachers. They also have lack of skills and knowledge about how to help prospective teachers in their practice. In addition, since most of mentor teachers are traditional science teachers, prospective teachers are rarely exposed to good role models during teaching practice. The third factor could be a university supervisor designing school experience and teaching practice. As the number of prospective teachers is highly large (approximately 60 prospective teachers), it is hard to get know all of them and their needs, and follow their professional development. The fourth factor could be school environment including students, the principal, other teachers in schools and parents. School environment has a key role to make prospective teachers feel as a part of the community rather than acting them as short-term visitors. The fifth factor could be the lack collaboration between the ministry of national education and universities. There must be flexibility in the implications of teaching practice considering prospective teachers' needs and interests.

Another significant finding of the present study was the lack of content knowledge the prospective teachers always indicated throughout the study. It is important because many scholars have been concerned about elementary teachers' content knowledge and their self-efficacy beliefs of teaching science (e.g. Huinker & Madison, 1997; Tosun, 2000). However, this study reveals that prospective science teachers felt that they had lack of content knowledge affecting their self-efficacy beliefs.

Acknowledgements

The authors would like to thank all reviewers for their valuable comments and participants for their contribution. This study is the part of the Master thesis completed by Suzan Tuna. This project was supported by Istanbul University Scientific Research Projects Fund with the project number 39348.

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