Sources of Teaching Efficacy Beliefs in Pre-service Science Teachers

Hediye Can[*]

ABSTRACT: The purpose of the present study was to understand how pre-service science teachers' teaching efficacy beliefs were shaped and what sources contributed to these efficacy beliefs. The researcher interviewed five students in their final year of an undergraduate elementary science education program. Bandura's (1997) hypothesized sources (mastery experience, vicarious experience, social persuasion, and emotional and physiological states) contributed pre-service science teachers' efficacy beliefs based on mastery experiences. Science content, knowledge, personality traits and resource provision are also mentioned by pre-service teachers as factors influencing their effectiveness. The results implied the importance of both school experience and faculty courses taken through undergraduate education. Future directions for research and practice were suggested.
Key Words: science teaching, sources of teacher efficacy beliefs, pre-service science teachers

INTRODUCTION

The issue of creating effective learning environments heavily depends on teachers' talents and behaviors. There is a common consensus on the idea that teachers' behaviors are guided with a set of organized beliefs (Clark & Yinger, 1979). Teaching efficacy beliefs are one of the key factors affecting teacher practices.

Teaching efficacy is defined as `the teacher's belief in his or her capability to organize and execute courses of action required to be successfully accomplished a specific teaching task in a particular context´ (Tschannen-Moran, Woolfolk Hoy & Hoy, 1998, p. 233). Teachers' beliefs in their efficacy affect their specific instructional practices and their general orientation toward the educational process (Bandura, 1997). Teachers with high teacher efficacy spend more time on planning and organizing, utilize effective classroom management techniques, maintain an openness to implementation of innovative classroom practices, devote more time to academic activities, interact more positively with students when they make errors, possess and increase willingness to work with students who experience difficulties, and they develop programs for special pupils. That effort has a positive influence on student outcomes such as motivation, achievement and students' personal self-efficacy. Teacher efficacy has impact on teaching behaviors and, therefore, indirectly influences student achievement and behavior (Conaway, 2010). Since teaching efficacy is an influential factor on student achievement and many other educational variables, investigation of the sources of this concept will be enlightening for further studies. Moreover, the development of teaching efficacy beliefs in pre-service teachers is important to continue teaching profession and to provide students with more opportunities to learn. Understanding the sources of the efficacy beliefs for science teachers plays a pivotal role in shaping and developing these beliefs as means of teacher education programs.

Bandura (1997) explained four types of information sources which are principal for construction of self-efficacy beliefs: enactive mastery experiences that serve as indicators of capability; vicarious experiences that alter efficacy beliefs through competencies and comparisons with other's attainments via modeling processes; verbal persuasion based on realistic expressions and physiological and affective states which people interpreted either positively or negatively. Moreover, he stated the importance of cognitive processing which governs the selection, interpretation and integration of efficacy information.

[*] Research Assistant, Adnan Menderes University, Faculty of Education, Department of Elementary Education, hediyecan@gmail.com

Specifically, there are few studies on formation and sources of teaching efficacy beliefs. Among those studies, quantitative studies are dominant. Researchers who focus on instructional efficacy proposed some other sources contributing to teaching efficacy in addition to Bandura's four sources. Palmer (2006) proposed that cognitive content mastery (success in understanding science content), cognitive pedagogical mastery (success in understanding how to teach science) and simulated modelling (in which teaching is role played) can be sources of self-efficacy in addition to those proposed by Bandura. Capa (2005), in her model which aimed to explain first year teachers' sense of efficacy, found that teacher program quality including information on different sources; mastery experience, vicarious experience and verbal persuasion had the highest weight on predicting teachers' efficacy levels, followed by principal support and teaching assignment. Tschannen-Moran and Woolfolk Hoy (2007) found teaching resources and interpersonal support, in addition to mastery experiences, made contribution to explaining teachers' sense of efficacy for novice teachers. Çapa-Aydın, Uzuntiryaki-Kondakçı, Temli and Tarkın (2013) found that Sources of Self-Efficacy Inventory (SOSI) that was developed by Kieffer and Henson (2000) based on Bandura's sources could be used in Turkish teachers' context according to the results of validity and reliability analysis. Among the four main sources stated by Bandura, mastery experience is consistently shown to be an important contributor to efficacy beliefs across studies. The evidence for other three sources seems to be more complicated. Additional sources explained by researchers need to be further investigated.

Based on the significance of teaching efficacy beliefs and minority of information on contributing sources to efficacy beliefs, present study aims to understand the sources and formation of teaching efficacy beliefs through interviews with pre-service teachers. The main focus is to answer the questions of "Which sources contribute to pre-service science teacher's efficacy beliefs?" and "How pre-service science teachers' efficacy beliefs are formed?" for the study.

METHOD

Research Design

The current study is based on qualitative methodology aiming to find answers to research questions mentioned above. As stated by Maxwell (1996), when trying to identify a phenomenon and to understand a process, qualitative research is a strong and suitable methodology. In the study, it is aimed to collect detailed data on the topic.

Participants

Five students in their final year of an undergraduate science education program participated in the study. Although students came from different regions of Turkey, they had similar educational background and teaching experiences. Two of them graduated from foreign language intensive high schools in which students are selected based on their scores obtained from an entrance examination after middle school. The other three student-teachers graduated from general public high schools. All the participants' subject was science and mathematics in their high school. Their age ranged from 21 to 25. They were all female.

Data Collection

Because of the unique nature of beliefs and the importance of understanding personal views of pre-service science teachers to interpret the data, semi-structured interviews were used as a data collection method in the study. Interview questions were prepared mainly based on the literature about sources of self-efficacy, and teacher competencies (MEB, 2008; Usher and Pajares, 2008; Usher, 2009). Aiming to understand the phenomenon better, some questions were also added which were expected to stimulate retrospective thinking. Actually, interview questions were prepared and listed together to elucidate the sources of teaching efficacy beliefs. One expert, whose research is focused on motivation in science education, was asked to assess the validity of

questions. Considering feedback from the expert researcher, some questions were added to the interview protocol. The interview questions are given in Appendix 1 and 2 in English and in Turkish.

Interviews took 43 minutes to 116 minutes; all interviews were tape recorded and transcribed verbatim. A total of 95 pages of raw data were collected.

Data Coding and Analysis

In this study, the data were analyzed through both deductive and inductive processes. Data from the transcribed interviews were coded and organized under categories, considering mainly predetermined categories based on Bandura's proposed sources, and when necessary additional categories were constructed. In that way, both descriptive analysis and content analysis were used. Codes, in relation to categories, were sometimes constructed from a sentence or a paragraph considering the consistency of the whole interview. Having read transcribed interviews carefully and tried to make sense of the data, it was aimed to ensure the categories were valid through comparisons. When necessary, new categories were created through inductive processes. Two researchers coded one of the interview transcripts for reliability concern (Miles and Huberman, 1994). They reached an agreement on the codes at the rate of %84.

The theoretical framework and data coding-analysis process is based on the literature regarding teacher beliefs in the field of education. The key characteristics of beliefs are compiled as follows: 1) Beliefs have informational bases which are evaluated and judged by the person himself/herself and not necessarily logically organized (to make a distinction among perceptions, knowledge and beliefs). 2) They have a degree of certainty and resistance to change for person. 3) They can be related to attitudes and behavior. Therefore, thorough the analysis process, these three aspects of beliefs are consistently taken into consideration to make a distinction among efficacy beliefs information, the formation process and pre-service science teachers' ideas of their effectiveness in science teaching. The coding schema is given in table 1.

FINDINGS

The findings are presented focusing on sources, based on related questions and how pre-service teachers interpreted their effectiveness on certain aspects of science teaching. The student-teachers are coded with capital letters; C, D, E, F, G.

Sources of Teaching-Efficacy Beliefs

In the interviews pre-service teachers usually talked about their teaching experiences as an efficacy belief source. Teaching experiences, which include actual learning environments with elementary students and simulated learning environments in pre-service teachers teaching methods courses or microteaching experiences, contribute pre-service teachers' teaching efficacy beliefs. All of the participants emphasized the importance of teaching experiences in the formation of their teaching efficacy beliefs. Teaching experiences inform pre-service teachers about their own effectiveness levels through non-verbal interactions, feedback from students, instructors and also social comparison. Vicarious experiences, affective states and social persuasion present a type of intertwined information that is based on teaching experiences. Some examples are given below:

> C: In this way… There is not a story. For example when I lecture on a topic without any preparation, my instructors liked it. That showed I can give a lesson even without preparation. That is enough for me. For example, when our friend was ill, I presented her topic. I didn't have any problems. There could be some deficiencies; however, I can overcome these issues with some experience. In any case it will be better with experience. I present my topic, I received good comments, I deserve this, and I again think I can do it.[1]

Table 1: Coding schema with major categories and codes

Themes	Categories	Example Codes	Description
Major sources contributing to pre-service science teachers' teaching efficacy beliefs	Teaching Experiences	In our school experience… when I teach… when I gave a course… While teaching, I see…I believe..	Experiences of teaching including science and the other subjects and previous successful attainments when mentioned directly or explained in detail
	Affective States	I feel happy… I enjoy… I love teaching… I'm excited, but that is good…	Emotions about teaching profession and affective reactions while teaching when considered as a reason to be a good teacher.
	Social Support	My family said "that job is becoming on you"… My friends said "you do it"… My instructor appreciated my teaching performance… The teachers can give a change us to assist them…	The persuasive verbal and non-verbal messages and social support coming from families, instructors, friends and mentor teachers including concrete attempts.
	Vicarious Experience	If someone is doing, the other ones can also do… I compare myself to the other… If they can't do with this experience, how can I do?..	Transferring the others success to her own by comparison or being effected by others' ineffective attempts.
Factors affecting formation of science teaching efficacy beliefs in pre-service science teachers	Science Content	The children love science in schools… Science is in our lives…	Defining science as a naturally interesting area and stating the importance of that structure's role in calling students' attention and motivation.
	Knowledge	I know it… We learned in faculty courses… I read articles on it…	Stating the role of a variety of different knowledge (pedagogical, pedagogical content, subject matter) types while stating teaching efficacy belief
	Perceived Personality Traits	I am shy, that affects my teaching… I am careful; I can understand what is happening in the classroom.	Bringing forward something which is perceived as a personality trait as a barrier or facilitator for achieving a specific teaching act.
	Resource Provision	Materials are also important… There should be laboratory…	Emphasizing the importance of existence of a type of source to effectively conduct teaching.

In the situation given above, the pre-service science teacher expressed a high-level of teaching efficacy belief which occurred after teaching experience in faculty courses. She emphasized positive feedback from instructor and also told she put little effort into this success.

A situation related to general achievement on diverse faculty courses contributed another pre-service teacher's efficacy belief, indicating that other successful attempts - which are not

necessarily related to teaching experience - have an effective role in constructing teaching efficacy beliefs.

> D: At university, second year… I have already thought that I could do it, but last year… My belief got stronger during the courses. I could tell, I could speak, I was better than my friends. When our instructor had an oral examination in teaching methods course or nature of science course, he didn't ask me any questions, he thought that I was successful. I kept one step ahead of my friends. Our instructor also confirmed that, so I thought that I could do it. It could be even better.. [2]

One of the pre-service teachers interpreted her affective states which occured during the teaching experiences and she compared her experiences with her other friends' experiences. In this situation pre-service science teacher interpreted vicarious experiences, affective states and students' response to instruction and she expressed an efficacy belief in teaching.

> F: I was very excited that day, I talked to myself, I said "I can do, I did it before". I presented so many topics. For example, I understood that my voice was fine yesterday. I compared myself with my friends. My friends lose their attention while they present a topic, but I understood that I can focus all attention on myself. I said that I can catch attention, they understand what I say. I can catch their attention even when teaching boring topics. And, we took community service course last year. I also felt children's attention on me, they understood what I said. I believed in myself, I believed that I could do. [3]

Perceived Effectiveness Level and Formation of Beliefs
The pre-service science teachers were asked to express their beliefs about different competency areas in science education. However, the answers to effectiveness questions did not have a certainty level which could be classified as efficacy beliefs. Therefore, the ideas of science teaching effectiveness and explanations of how to achieve specific goals were classified as factors contributing to formation of efficacy beliefs. Pre-service teachers sometimes tried to make a cognitive simulation of the situation in order to try to find an answer to the question due to lack of enough teaching experience in actual science classrooms.

Observation of Different Teaching Conditions
Through the observations of the public elementary schools, pre-service teachers get information on their effectiveness level. They try to understand the situations in the classroom, and they observe students and teacher behaviors, they empathize with teachers. If they observe undesired events in classroom, they often feel anxious and think how they can cope with these events without any experience.

> G: …I go to elementary schools for school practice. I observe 7th grade students. I saw one student threw a pencil at his friend. He was nearly injuring his friend's eye. I felt anxious, very anxious… [4]
> E: …I sometimes think what I can do in such a situation. We observe the lesson bewildered. Do these students behave in that way because of our presence in classroom? [5]

Pre-service science teachers sometimes emphasize the lack of chance to observe different classrooms. For instance, when they observe a lot of undesired behaviors, they cannot obtain knowledge of effective science instruction. Furthermore, if they see ineffective classroom management and incompetent styles of teachers, they express that they feel highly anxious. Based on their statements about their observations, it is understood that they mostly did not find any chance to observe effective teacher behavior and good teaching practices. In a sense, that may make them feel more competent than those teachers in public schools; however, it may also raise their awareness of their shortcomings.

C: …I see they are having difficulties. They have experience of 25 years, they still have difficulties… I sometimes feel anxious how I can handle it without any experience…[6]
C: … I sometimes think that I can teach that subject perfectly and much better than that teacher…[7]

Science Content

While talking about creating constructive learning environments, some pre-service teachers underlined the science content structure and scientific knowledge. They matched science with practice and daily life and stated that they can use variety of methods and techniques in science teaching. The student-teachers who talked about science content structure also mentioned that they loved science and read popular science books and articles on science teaching. A pre-service teacher directly mentioned the science content as a source of building efficacy on changing students' attitude towards science.

D: I think, I can make them love science. Anyway, students like science. It is visual, concrete and intuitive. They like science… [8]
G: I think, I can do. Because, science is not like mathematics for example, it is not based on formulas or it is not like Turkish. It is not based on verbal expression competency. Science is in our lives. Ok, there is theoretical knowledge, but we obtain it from our daily lives. For example, children play with ball, they throw it. You can teach science from their play; force and motion for example…[9]

Knowledge

Pre-service science teachers perceived that their knowledge contributes to their ideas on their teaching efficacy. Knowledge includes science content knowledge, pedagogical knowledge and pedagogical content knowledge. The most mentioned knowledge type was pedagogical content knowledge including specific techniques and methods to teach a certain topic in science. On the other hand, pedagogical knowledge especially in terms of classroom management is also mentioned by pre-service teachers. When asked about planning, assessment and evaluation, they stated that they learned them in the educational science courses; however they had never used theoretical knowledge in real settings, so they expressed a malleable thought about their effectiveness level on these issues. The category knowledge also seems to be well connected to experience and practice. Science content knowledge is also mentioned by student-teachers. When they are more familiar with the content, they seem to provide more sources to themselves as means of different strategies and reasoning styles.

E: Maybe because of thinking I have inadequate knowledge in science, maybe feeling anxious about giving wrong information. When I have enough knowledge, when I trust myself… I tell again and again, but I can't add anything. I don't know if it is due to lack of knowledge or capacity…[10]
D: …For example I read articles, I worked hard, 'what can we do, how can we do'… It can be hard at first, but I think, I can do. [11]
F: …We didn't learn the content in accordance with the level of students… How can we teach it to students? We learned either hard or we didn't learn… That affected me. I was nearly losing my belief…[12]

There also seems to be a connection between science content knowledge and student-centered learning environments. Students frequently mentioned specific science lessons in terms of student centrality and instructor behavior. They expressed that they learned better in student-centered learning environments although they were not aware of the methods used in these courses. They also mentioned that they remembered the application of certain methods from their own learning experiences at university. They emphasized the importance of an instructor as a practitioner of specific teaching methods. Modeling these methods by a credible practitioner seems to provide them with an alternative source for finding solution to their problems about the

application of these methods. Due to lack of practice on specific teaching methods in public schools, they just have practical knowledge from their university courses.

> G: …In fact, learning through discovery is a type of method which our instructor uses frequently. He brings up our ideas, refines them and finds the right ones… Because of seeing it in his practice, it became easy to use this method in my own teaching experience…[13]

Personality Traits

Pre-service teachers think that some personal characteristics such as shyness, emotionality and nervousness can be a barrier to being a competent teacher. On the other hand, perceptions on having characteristics like being social, careful or analytical contribute to their efficacy beliefs.

> F: My personality is better, I think. I like children, I like explaining… I should be calm. I shouldn't be very emotional. [14]
> C: I always think how I can call children's attention. Even, I can call a two-year-old child's attention on myself… I observe… I am careful… I can understand how something happened… So I can make student pay attention to lesson. [15]

Perceived personality traits also contribute to pre-service teachers' efficacy beliefs through their perceptions on the characteristics of an effective teacher. Sometimes, we see common statements on their personality perceptions and perceived profession requirements. Some examples from different students are given below:

> E: … I am thoughtful, sensitive… I'm social, yes… [16]
> E: … They are learning what we teach… So, we should behave so delicately… We should develop ourselves, we are social in this sense (as science teachers)… [17]
> G: …I'm curious… I'm interested in technological and scientific developments, I enjoy research… I like cooperation… I'm thoughtful…[18]
> G: ..A teacher doesn't necessarily know everything, but s/he must investigate… Also s/he must involve himself/herself in students problems… must be fair… [19]

Resource Provision

This category emerged through pre-service teachers' statements about the fact that they could create certain learning environments as long as they reach necessary sources. Especially based on their observations of elementary public schools, they usually emphasized that teachers did not use materials, educational technologies or laboratory for science courses. Some of them said they even do not know if there was a science laboratory in practice school.

> G: Laboratory… In fact, it is a requirement for science and technology… Necessary materials should be there. If we don't have materials while teaching, it can be very problematic…[20]

Only one of pre-service teachers emphasized the importance of teacher as a resource provider. She criticized public school teachers on the issue.

> C: …I don't know if there was a laboratory in school because the teachers don't conduct experiments. Except from that, they have basic materials such as computer and projector but they don't use them. I even don't know if these materials out of order… There is a bookshelf, but it is empty… These are not the problems of school. You can find books, if you want to do. However, the teachers do not make an effort to do that… Use the computer in the classroom and projector, so the students will also see what you are looking at your own computer!.. Maybe students will comprehend the subject better if you use these materials instead of using just blackboard… [21]

Pre-service science teachers' think that they can be effective teachers according to their mastery experiences. In this process they compare themselves with their student-teacher friends also they get feedback from their students, friends, and instructors about their performance. However, when they encounter different situations regarding teaching, they assess their knowledge, and the topic. They realize that they have limited experience. Therefore, their answers to effectiveness questions reflect their ideas on their effectiveness about a future event.

DISCUSSION and IMPLICATIONS

This part of the study includes discussion and implications for teacher educators and researchers based on findings from the interviews considering the limitations of the study.
In this research the aim was to understand pre-service teachers' beliefs about their teaching efficacy and related sources which contributes to their beliefs. We see that we could use the framework proposed by Bandura (1997) for categorizing their sources of efficacy beliefs. All of the four proposed sources contributed to pre-service science teachers' efficacy beliefs in an intertwined manner based on mastery experience. However, we should keep in mind that except for real teaching experiences, all simulated experiences which include microteaching experiences and practice-based faculty courses contribute to their beliefs about teaching efficacy. In fact, the importance of teaching experiences in shaping pre-service teachers teaching efficacy beliefs was emphasized by different researchers (Tosun, 2000; Poulou, 2007; Usher, & Pajares, 2009; Cakiroglu, Capa-Aydın, & Woolfolk-Hoy, 2012). Pre-service teachers' previous achievements are also likely to contribute to their efficacy beliefs. We may think this category in relation to enactive mastery experience. The previous attainments on diverse topics seem to be transferred to their teaching efficacy beliefs. When a student thinks about her attainments in the academic area in past, she is likely to think she can be successful in her future career also. In this situation, all student-teachers in our study, with no exception, think that they can be an effective teacher if they study more about teaching. In the area of science teacher education, it is usually emphasized that all students can learn when individual differences taken into consideration and learning environments are designed with a variety of activities. Internalization of this idea may lead pre-service science teachers to think that they can also be a good science teacher by working and concentrating on the teaching issue. On the other hand, this may be just a matter of an optimistic mood with the effect of being in the last year of their teacher education program. On the issue of experience, we can say that social persuasion and affective states seem to be highly interrelated with experiences of students. They generally get feedbacks after their teaching experiences and these feedbacks effect their perceptions of teaching efficacy. When feedback comes from the students and it is followed by a performance, it seems to be very effective. Students also mention social persuasion coming from their families; however, that persuasion does not seem to be very effective for some students. On the other side, one student who is supported by her family constantly expressed her trust to her family's ideas. Based on that trust she seemed to be effected by social persuasion coming from her family. She clearly stated that her family was a motivation source for her career. An insight emerging from this statement, student-teachers who are more likely to feel efficacious for science teaching, expressed familial support for their career and a flexibility given to them for their career choice. Familial effect seems to be important despite increased age of pre-service teachers. However, the internalization of the career choice, regardless of how teaching profession was chosen, may play a role in their efficacy beliefs toward science teaching. That is again an argument indirectly emerging through interpretations of interview data, so there is a need to assess that argument through further research studies.

Pre-service teachers mentioned the unwillingness of mentor teachers to help them about teaching in public schools. Two of the students stated that they could not get any support from their teachers. One of them emphasized that she cannot observe the teacher in confidence, because she usually felt that the teacher did not want them in the classroom. The other student

stated that the teacher left the classroom for her own problems and she conducted lesson without being volunteer. The observed levels of effectiveness of those mentor teachers were low according to student-teachers. So, only with one exception, pre-service teachers expressed the ineffectiveness of public school teachers, both in terms of competency and support. The exceptional student is the one who expressed lower efficacy belief compared to the others. She said that she was satisfied with school experience course. We can say that those public schools do not satisfy pre-service teachers' expectations.

Familial support, mentor teacher support, and social persuasion can be called as social support. Support from social environment on a concrete base, either in terms of a persuasive talk following teaching experiment or a well-balanced support, seem to be influential in shaping student-teachers science teaching efficacy beliefs.

In the teaching process their affective states also change and those pre-service science teachers are likely to interpret their excitement as a good state and they say they feel happy while teaching. Just one student says that she is not excited while teaching and she does not enjoy teaching. This student also has some doubts about her effectiveness level on science teaching. These student-teachers seem to be highly emotional in that sense. Some of these teachers expressed that they loved teaching. They emphasized the importance of loving your job to effectively do it. Science teaching efficacy beliefs may be related to attitudes towards teaching and also science. Attitudes toward science are investigated and found to be related to self-efficacy beliefs (e. g. Ramey-Gassert, Shroyer, & Staver, 1996). That issue can be a matter of further investigation.

Pre-service teachers sometimes compare themselves with teachers, and also they compare themselves with their student-teacher friends. Their observations also provide them with a valuable knowledge of learner and effective teacher styles. That issue is an important one for teacher education. Because, we see that those student-teachers cannot find any chance of observing different schools which includes a variety of students from different sociocultural backgrounds and also really competent and stylistic teachers. Relatively low sociocultural backgrounds of schools may affect their expectations from a competent teacher. For example, the chance of observing private school teachers may change their efficacy beliefs. Therefore, more opportunities should be provided to teacher-students as means of observing effective teaching styles under different circumstances.

These pre-service teachers do not seem to be aware of the effectiveness of a teaching process. However, effective teaching issue is sometimes hard to understand and identify by researchers as well. Our questions about the competency areas worked as an awareness probe in this study. When they faced with a phenomenon that they did not think before, they usually try to find a previous success about the issue. If they cannot find any attainment on that issue, they give answers based on their perceived knowledge level on that issue. If they think that they have enough knowledge on the issue they think they can achieve it with some experience. In a manner, faced with an unexpected reality, their knowledge base guides them to produce an answer for their effectiveness level. Thus, knowledge, referring to perceived level of knowledge, seems to be related to teaching efficacy beliefs. Pre-service teachers need knowledge of practice, knowledge of theory, knowledge of learners, and knowledge of content to make decisions on their efficacy levels. They use vicarious experiences, faculty courses or even scientific research to increase their knowledge level. Maybe, increased knowledge makes them feel more confident. This general confidence level can be influential on their teaching efficacy beliefs specifically. From the perspective of knowledge acquisition, we can also see the formation of teaching efficacy beliefs as a process built on knowledge, experiment and attitude which is based on cognitive processing. However, we should be cautious about interpretations. We cannot simply say that if we provide them more opportunities to increase their knowledge level, they will feel more efficacious. We can say presenting more opportunities to increase their knowledge through a variety of observations, hands-on activities and research may provide them with a more realistic stance for

their effectiveness level. At the same time, interviews can be seen as an awareness education, like this one. Therefore, we should give them opportunities of learning environments on diverse educational topics through group discussions, reflections and interviews conducted with the assistance of an expert.

Pre-service science teachers clearly stated that their personality traits also influence their effectiveness in teaching. This result is in line with some other research (Ramey-Gassert, Shroyer, & Staver, 1996; Poulou, 2007). On the other hand, personality traits, which are assessed as a barrier for effective teaching by student-teachers, are seen as changeable traits by them. In fact, one of these student-teachers stated that she puts effort to overcome her shyness rid herself of. As we mentioned above, these students also think that they can be successful if they study on the issue of teaching. These two situations are consistent with each other. Considering the high level of efficacy beliefs of these teachers, we may think that flexible thinking may be helpful for enhancing teaching efficacy beliefs. However, that is another argument for research, especially since we did not know the actual personality characteristics or thinking styles of these student-teachers. Maybe, some type of personality traits can be effective in formation of teaching-efficacy beliefs. In fact, there is some research on this issue (for e.g. Senler & Sungur, 2013). As mentioned before; however, these pre-service teachers' beliefs about malleability of their traits and abilities with effort imply that they may be successful in their future career. That is a long term issue and needs to be investigated further. Another issue is that they in fact may not be flexible in their thinking styles although their attributions may be prone to change. In a sense, contradictorily, we understand that they adopt a lot of traditional beliefs about teaching. They emphasize the importance of lecture while talking about teaching, and also they usually emphasize that they can recite well when talking about their efficacy beliefs. In deep inquiry on different competency areas, they seemed to lose their confidence. So, their thinking styles or even critical thinking abilities in relation to teaching efficacy beliefs can be an issue of investigation.

In this study, the process of formation of pre-service teachers' beliefs is similar to those proposed by Tschannen-Moran, Woolfolk-Hoy and Hoy (1998). Bandura's (1997) sources of self-efficacy information are at the hearth of the process. Other factors such as observation of different teaching conditions, perceived knowledge level, perceived personality traits, resource provision and perceived structure of science content seem to be influential in forming pre-service science teachers' teaching efficacy beliefs as distant factors. The relationships among the factors effecting pre-service science teachers' teaching efficacy beliefs can be an issue for further investigation.

Finally, it is important to consider that their undergraduate experiences have a vital importance in shaping their science teaching efficacy-beliefs. Therefore, more hands-on activities, research projects, laboratory experiments, variety of school visits with student-teachers, and student-activated learning environments will be influential to help pre-service science teachers to find solutions to teaching issues. In summary, we should provide opportunities to observe and to investigate about education for pre-service science teachers.

REFERENCES

American Psychological Association. (2010). *Publication manual of the American Psychological Association (6th ed.)*. Washington, DC: Author.

Bandura. A., (1997). *Self-efficacy: The exercise of control*. NY: W. H. Freeman and Co.

Cakiroglu, J., Capa-Aydin, Y., & Woolfolk-Hoy, A. (2012). Science teaching efficacy beliefs. In B. J. Fraser, K. G. Tobin, & C. J. McRobbie (Eds.), *Second International Handbook of Science Education* (pp. 449-462). USA: Springer.

Capa, Y. (2005). *Factors influencing first-year teachers' sense of efficacy*. (PhD Thesis). Available from etd.ohiolink.edu/ap:10:0::NO:10:P10_ETD_SUBID:63702

Capa-Aydın, Y., Uzuntiryaki-Kondakcı, E., Temli, Y. & Tarkın, A. (2013). Adaptation of sources of self-efficacy inventory into Turkish. *Elementary Education Online*, *12*(3), 749-758.

Clark, C. M., & Yinger, R. J. (1979). Teachers' thinking. In P.L. Peterson & H. J. Walberg (Eds.), *Research on Teaching* (pp. 231-263). USA: McCutchan Publishing Cooperation.

Conaway, K. A. (2010). Teacher efficacy. In C. S. Clauss-Ehler (Ed.), *Encyclopedia of Cross-Cultural School Psychology* (pp. 966-968). USA: Springer.

Maxwell, J. A. (1996). *Qualitative research design: An interactive approach*. USA: SAGE Publications.

MEB, (2008). *Öğretmen yeterlikleri, Öğretmenlik mesleği genel ve özel alan yeterlikleri.* Ankara: Devlet Kitapları Müdürlüğü. retrieved from http://otmg.meb.gov.tr/YetGenel.html

Miles, M. B. & Huberman, A. M. (1994). *Qualitative data analysis*. USA: SAGE Publications.

Palmer, D. (2006). Sources of self-efficacy in a science methods course for primary teacher education students. *Research in Science Education*, *36*, 337–353.

Pintrich, P. R., & Schunk, D. H. (2002). *Motivation in education: Theory, research, and applications (2nd ed.).* Upper Saddle River, NJ: Pearson Education, Inc.

Poulou, M. (2007). Personal teaching efficacy and its sources: student teachers' perceptions. Educational Psychology: *An International Journal of Experimental Educational Psychology*, *27*(2): 191-218. doi: 10.1080/01443410601066693

Ramey-Gassert L., Shroyer, M. G. & Staver, J. R. (1996). A qualitative study of factors influencing science teaching self-efficacy of elementary level teachers. *Science Education*, *80*(3): 283-315.

Senler, B. & Sungur, S. (2013). Pre-service science teachers' teaching self-efficacy in relation to personality traits and academic self-regulation. *The Spanish Journal of Psychology*, 16: E12 doi: dx.doi.org/10.1017/sjp.2013.22

Tosun, T. (2000). The beliefs of pre-service elementary teachers towards science and science teaching. *School Science and Mathematics*, *100*, 374–379.

Tschannen-Moran, M., Woolfolk Hoy, A., & Hoy, W.K. (1998). Teacher efficacy: Its meaning and measure. *Review of Educational Research*, *68*(2), 202-248.

Tschannen-Moran, M., & Woolfolk Hoy, A. (2007). The differential antecedents of self-efficacy beliefs of novice and experienced teachers. *Teaching and Teacher Education*, *23*, 944–956.

Usher, E. L. (2009). Sources of middle school students' self-efficacy in mathematics: A qualitative investigation. *American Educational Research Journal, 46*(1): 275-314. doi: 10.3102/0002831208324517

Usher, E. L. & Pajares, F. (2008). Sources of self-efficacy in schools: critical review of the literature and future directions. *Review of Educational Research*, *78*(4): 751-796. doi: 10.3102/0034654308321456

Wheatley, K. F. (2005). The case for reconceptualizing teacher efficacy research. *Teaching and Teacher Education*, *21*, 747-766. doi: 10.1016/j.tate.2005.05.009

Fen Bilgisi Öğretmen Adaylarının Öğretim Yeterliği İnanç Kaynakları

ÖZ: Bu araştırma fen bilgisi öğretmen adaylarının öz-yeterlik inançlarının nasıl şekillendiğini ve hangi kaynakların öz-yeterlik inançlarına katkıda bulunduğunu araştırmayı amaçlamaktadır. Araştırmacı bir fen bilgisi öğretmenliği programında öğrenim gören ve son sınıf öğrencisi olan 5 öğretmen adayıyla görüşmeler yapmıştır. Bandura (1997) tarafından öne sürülen öz-yeterlik inanç bilgi kaynaklarının (dolaylı deneyimler, sözel ikna ve duyuşsal durumlar) öğretmenlik deneyimleri temelinde öğrencilerin öğretim yeterliliği inançları hakkında karar vermelerinde etkili olduğu görülmüştür. Fen konu alanının analizi, algılanan bilgi düzeyi ve kişilik özellikleri ile kaynak temini gibi etmenlerin de öğretmen adayları tarafından dikkate alındığı görülmüştür. Sonuçlar okul deneyimi ve öğretmenlik öğrenimi sürecinde alınan derslerin kalitesinin ve içeriğinin önemini vurgular niteliktedir.

Anahtar Kelimeler: fen öğretimi, fen öğretmen adayları, öğretim yeterliliği inanç kaynakları

Amaç ve Önem

Kişilerin özgül bir işi başarabilmelerine yönelik inançları öz-yeterlik olarak tanımlanmakta ve kişilerin o işe başlayabilme ve işi devam ettirebilmelerinde önemli bir rol oynamaktadır. Öğretmeye yönelik yeterlik inancı bir öz-yeterlik inancı olup Tschannen-Moran, Woolfolk Hoy ve Hoy (1998) tarafından tanımlanmıştır. Öğretmenlerin, öğretime yönelik yeterlik inançlarının yüksek olmasının, öğretime yönelik davranışlarını olumlu yönde etkilediği bilinmektedir. Bu araştırmada fen bilgisi öğretmen adaylarının fen öğretimine yönelik öz-yeterlik inanç kaynakları araştırılmıştır. Fen öğretimine yönelik yeterlik inanç kaynaklarının araştırılmasının, yeterlik inancının öğretim için tanımlanması ve arttırılmasına yönelik uygulamalara ışık tutması yönünden önemli olduğu düşünülmektedir.

Yöntem

Araştırmada veriler yarı yapılandırılmış görüşmeyle toplanmıştır. Fen bilgisi öğretmenliği dördüncü sınıfta öğrenim görmekte olan 5 öğretmen adayı çalışmaya katılmıştır. Verilerin analizinde Bandura tarafından önerilen dört öz-yeterlik inanç kaynağı "doğrudan deneyimler, dolaylı yaşantılar, sosyal ikna ve duyuşsal durumlar" temel alınmıştır. Bu dört kaynağın dışında kaldığı düşünülen durumlar için yeni kategoriler oluşturulmuştur.

Bulgular

Fen bilgisi öğretmen adaylarının öğretim yeterliliği inançlarının temelinde doğrudan deneyimler (öğretmenlik deneyimleri) bulunmaktadır. Öğretmen adayları bu süreçte dolaylı deneyimler, sözel ikna ve duyuşsal durumlarını da yorumlayarak karar vermektedir. Karşılaşılmayan bir öğretim durumunda konu alanının, algılanan bilgi düzeyinin, algılanan kişilik özelliklerinin ve kaynak temininin de karar verme sürecinde etkili olduğu görülmüştür. Fen bilgisi öğretmen adaylarının öğretim yeterliliği inançlarının oluşmasında kendi öğretmenlik deneyimlerinin ve üniversite öğrenimi süresince yer aldıkları sorgulayıcı, araştırmacı ve öğrenci merkezli öğrenme ortamlarının önemli rol oynadığı görülmektedir.

Tartışma, Sonuç ve Öneriler

Öğretime yönelik yeterlik inancının, görüşülen öğrencilerde temel olarak üniversite eğitimi boyunca oluşmaya başladığı ve öğretim uygulamalarının öğrencilere kaynaklık ettiği görülmüştür. Daha geniş ve heterojen örneklemlerle yapılacak nitel ve nicel araştırmalara ihtiyaç duyulmaktadır. Aynı zamanda öğretmen adaylarının öğretim yaşantılarının ve öğretmenlik deneyimlerinin zenginleştirilmesine yönelik uygulamaların arttırılmasının öğretime yönelik yeterlik inançlarına katkı sağlayacağı düşünülmektedir.

Can you tell me about yourself?
What sort of personality do you have?
Can you tell me about your family?
What sorts of things do you enjoy doing outside school?
 Is there anyone do you admire?

Which high school did you graduate from?
Did you enjoy science lessons in high school?
What was your favorite subject in high school?
Can you tell me a memory of you from science lessons?

How did you choose that profession, do you have a story?
What is the meaning of teaching for you?
What does your family think about your profession?

Have you ever thought that you could not teach? How do you cope with this thought?
Do you have story which increased your belief to do that job?

How do you evaluate your teaching efficacy on science?
* Conceptual knowledge, pedagogical knowledge, classroom management, planning, assessment and evaluation, constructivist learning, expression, science teaching methods and laboratory, motivating students on science learning, participating students to learning process.

Do you think that you are successful, why?
Which aspects of your teaching need to be better?
Which issues are the hardest for you in teaching?
How do you compare science teachers with other teachers?

What do your friends think on your teaching competencies?
What do you think on your friends' science teaching competencies?

Is there any one you admire in terms of her/his teaching? Can you talk about that person?

How do you feel while teaching, or how do you feel when you think of a situation that you teach?

Do you have any experience on teaching outside the faculty?
Do you think that these experiences contributed to your effectiveness level?
Do you think you could teach?

Do theoretical courses contribute your belief on your teaching efficacy?
Do practical courses contribute your teaching efficacy belief?
Can you give me more detailed information on each of the areas mentioned?
*Science content courses, laboratory courses, educational sciences courses, method courses, school experience.

What do you think about the teachers in public schools based on your observations?
Did they support you, how?
In what ways they could be make you feel better?

Is there anything different you want to say?

Bana kendinden bahseder misin?
Nasıl bir kişiliğin var?
Biraz ailenden bahseder misin?
Okul dışında neler yaparsın?
Örnek aldığın birileri var mı?

Hangi liseden mezun oldun?
Lisedeyken fen derslerini sever miydin?
Lisede en sevdiğin ders hangisiydi?
Bana fen derslerinden bir anını anlatır mısın, liseden veya ortaokuldan?

Bu mesleği nasıl seçtin, bir hikayen var mı?
Öğretmenlik senin için ne ifade ediyor?
Ailen mesleğin hakkında ne düşünüyor?

Hiç öğretmenlik yapamayacağını düşündüğün bir an oldu mu, bu düşünceyle nasıl baş ettin?
Öğretmenlik yapabileceğine dair inancının artmasına sebep olan bir olay yaşadın mı?

Fen öğretimine yönelik yeterliliğini nasıl değerlendirirsin?
*kavramsal bilgi, pedagojik bilgi, sınıf yönetimi, planlama, ölçme ve değerlendirme, yapılandırmacılık, anlatım ve ifade, özel öğretim yöntemleri ve laboratuvar, öğrencileri fen öğrenmeye motive etme, öğrencilerin öğrenme sürecine katılımını sağlama.

Başarılı olduğunu düşünüyor musun, neden?
Hangi yönlerini geliştirmen gerektiğini düşünüyorsun?
En çok zorlandığın şey ne?
Kendini öğretim konusunda diğer arkadaşlarınla nasıl kıyaslarsın?

Arkadaşların öğretmenliğin hakkında ne düşünüyor?
Sence arkadaşlarının öğretmenliği nasıl?

Öğretmenliğini takdir ettiğin biri var mı? Biraz bu kişiden bahseder misin?

Öğretmenlik yaptığını düşündüğünde ya da öğretmenlik deneyimlerin esnasında nasıl hissediyorsun?

Üniversite dışında öğretmenlik deneyimin var mı?
Bu deneyimler etkililik düzeyine katkı sağladı mı?
Öğretmenlik yapabildiğini düşünüyor musun?

Teorik dersler öğretmenlik yapabileceğine dair inancına katkı sağladı mı?
Uygulama dersleri öğretmenlik yapabileceğine dair inancına katkı sağladı mı?
Her bir dersle ilgili detaylı bilgi verir misin bana?
*Fen alan dersleri, laboratuvar, eğitim bilimleri dersleri, yöntem teknik dersleri, okul deneyimi.

Okullardaki öğretmenler ile ilgili ne düşünüyorsun?
Okullardaki öğretmenler sana destek oldu mu, nasıl?
Nasıl davransaydılar kendini daha yeterli hissederdin?

Eklemek istediğin başka bir şey var mı?

Şöyle… Aslında hikaye yok ama konu anlatırken mesela hiç hazırlıksız olup da konu anlattığımda hocalarımın çok beğendiği çok oldu. Bu da benim hazırlıksız olarak bile ders anlatabileceğimi aktarabileceğimi gösterdi, bu da benim için zaten yeterli oluyor. Mesela arkadaşımız rahatsızlandığında onun sunumunu kalkıp ben yaptım aynı grupta olduğumuz için. Hiç sıkıntı çekmedim tamam belki bazı eksiklikler olur ama hani bunlar deneyimle giderilebilecek eksiklikler, önceden çalışmayla falan değil, deneyim. Birazcık deneyim kazandıktan sonra illaki düzelecek. O yüzden dediğim gibi ben hani kalkıyorum işte dersimi anlatıyorum iyi yorumlar aldığım zaman evet işte ben buna layığım yapabilirim diye düşünüyorum tekrardan. [1]

Burada ikinci sınıfta sanırım, zaten istiyordum yapabilirim falan diyordum ama geçen yıl- geçen yıl derslerde çok güçlendi. Anlatabiliyordum, konuşabiliyordum, sınıf arkadaşlarımdan daha etkindim, hatta hoca, bize sözlü sınav yapıyordu, özel öğretim yöntemleri 1, bilimin doğası falan, sınavımız sözlüydü. Bana hiç soru bile sormadı, zaten iyi olduğumu düşünüyordu, sınıf arkadaşlarımdan daha ilerdeydim yani. Bunu hoca da dile getirdi, yapabileceğimi düşündüm ondan sonra. Daha iyi olabileceğimi düşündüm yani.[2]

O an çok heyecanlıydım önceden, sonra diyorum ki sen yaparsın, önceden de yapmıştın baya sunumlar yapmıştın. O an mesela dün anlatıyordum ses tonumun falan iyi olduğunu anladım, sınıftakileri gözlendiğim diğer arkadaşlarımla kendimi kıyasladım, dikkatleri dağılıyordu ama ben mesela bir tek dün değil önceki konu anlatımlarımda da gözlemledim, o an sınıfa anlatırken, kendime odaklayabiliyorum bütün sınıf arkadaşlarımı. Dedim hani dikkat çekebiliyorum ses tonum anlaşılıyor. Sıkıcı şeylerde bile kendime çevirebiliyorum. Bir de geçen sene topluma hizmet dersine gitmiştik. Orada da böyle çocukların dikkatini falan çekebiliyordum böyle, dediklerimi de anlıyorlardı. O zaman daha da bir güvenim geldi, yapabileceğime inandım.[3]

Staja gidiyorum. 7. sınıf öğrencilerini gözlemliyorum. Öğrencinin biri arkadaşına kalem fırlattı. Neredeyse gözüne geliyordu. Korktum, çok korktum.[4]

Böyle bir durumda ne yapardım diye düşünüyorum bazen. Dersi şaşkınlık içinde gözlemliyoruz. Öğrenciler biz varız diye mi böyle davranıyor…[5]

Zorluk yaşadıklarını görüyorum. 25 yıllık deneyimleri var ve hala zorlanıyorlar… Bazen hiç deneyimim olmadan nasıl yapacağım diye endişeleniyorum.[6]

Bazen o konuyu kusursuz şekilde, hocadan çok daha güzel bir şekilde anlatabileceğimi düşündüğüm noktalar oluyor…[7]

Ya, sevdirebileceğimi düşünüyorum. Zaten öğrenciler okullarda fen derslerini seviyor. Görsel, somut ve mantığa uygun… Feni seviyorlar.[8]

Evet düşünüyorum. Çünkü fen bir matematik gibi formüllere dayanmıyor, ya da bir Türkçe gibi sözlü anlatım gücüne. Fen bilgisi aslında hayatın içinde… Tamam, teorik bilgi var işin içinde, ama biz bunu hayatın bizzat kendisinden elde ediyoruz. Çocuklar top oynuyorlar mesela, top atıyorlar. Bu top oyunlarından bile bir fen öğretimi yapılabilir, kuvvet ve hareket…[9]

Belki fende eksik bilgilerim olduğunu düşündüğüm için, belki yanlış bilgi vermekten korktuğum için. Eksik bilgilerimi tamamladığımda, kendime güvenim geldiğimde…Tekrar tekrar anlatıyorum ama yeni bir şey ekleyemiyorum. Bilgi eksikliğinden mi, yoksa kapasite mi bilmiyorum…[10]

Mesela çok makale okudum, çok çalıştım, ne yapabiliriz, nasıl yapabiliriz… Başlangıçta zor olabilir, ama yapabileceğimi düşünüyorum. [11]

Çocukların seviyesine uygun olarak öğrenmedik hiç… Nasıl öğreteceğiz? Ya çok zor öğrendik, ya hiç öğrenmedik… Bu beni etkiledi. Neredeyse inancımı yitiriyordum…[12]

Aslında buluş yoluyla öğretim bizim hocamızın sıklıkla uyguladığı bir yöntem. Fikirleri topluyor, ayırıyor ve doğru olanları buluyor… Hocanın uygulamasında bunu gördüğüm için, kendi öğretim deneyimlerim esnasında kullanmam kolay oldu. [13]

Kişiliğim daha iyi bence. Çocukları seviyorum, anlatmayı seviyorum… Sakin olmalıyım. Çok duygusal olmamalıyım. [14]

Çocukların ilgisini nasıl toplayabilirim diye çok düşünen bir insanım. İki yaşındaki bir çocuğun ilgisini bile çekebiliyorum… Gözlem yaparım… Dikkatliyimdir… Bir şeyin nasıl olduğunu anlarım… Bu yüzden çocukların ilgisini toplayabilirim. [15]

Düşünceliyim, duyarlıyım… Sosyalim, evet. [16]

Ne öğretirsek onu öğreniyorlar… Bu yüzden duyarlı davranmalıyız… Kendimizi geliştirmeliyiz,.. Bu anlamda sosyaliz. [17]

Meraklıyım… Bilimsel ve teknolojik gelişmelerle ilgilenirim, araştırmayı severim… İşbirliğini severim… Düşünceli biriyim… [18]

Bir öğretmen her şeyi bilmek zorunda değil ama araştırmak zorunda… Hem de öğrencilerin problemleriyle ilgilenmeli… Adil olmalı. [19]

Laboratuvar… Fen ve teknolojide olması lazım… Ayrıca gerekli materyaller de olmalı. Öğretirken materyaller olmazsa çok sorun yaşayabiliriz. [20]

Okulda bir laboratuvar var mı, bilmiyorum. Çünkü öğretmenler deney yapmıyor. Bunun haricinde bilgisayar ve projeksiyon aleti gibi temel materyaller var, ama onları da kullanmıyorlar. Bu aletler çalışıyor mu bilmiyorum… Kitaplık var ama boş… Bunlar okulun problemleri değil. Eğer istersen kitap bulabilirsin. Ama öğretmenler çaba sarf etmiyor… Sınıftaki bilgisayarı ve projeksiyon aletini kullan, böylece öğrenciler sen kendi bilgisayarında nereye bakıyorsun görsün!.. Belki de öğrenciler, öğretmen sadece tahtayı kullanmak yerine materyalleri kullansa konuyu daha iyi anlayacak. [21]