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Research Article

The Teaching Processes of Prospective Science Teachers with Different Levels of Science-Teaching Self-Efficacy Belief*

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Abstract

The concept of self-efficacy, which is an important variable in the teaching process, and how it reflects on teaching have recently been the focus of attention. Therefore, this study deals with the relationship between the science-teaching self-efficacy beliefs of prospective science teachers and their teaching practices. It was conducted with four prospective science teachers who were in their final year at a state university. The teaching processes of prospective science teachers, all of whom had different levels of science teaching self-efficacy beliefs, were detected using the case study, a qualitative research method. Observations, interviews, and documents were used as data collection tools. The obtained data were analyzed through the method of content analysis. According to the findings, although the prospective science teachers were observed to have different levels of self-efficacy belief, they agreed that the student-centered approach was more suitable for students, especially in terms of the teaching process. However, they reflected this differently in their practices. Contrary to expectation, it was generally confirmed that teachers with high-levels of self-efficacy might perform their teaching practices less efficiently in some situations, while teachers with low-level of self-efficacy might perform their teaching practices more efficiently.

Keywords

Science teaching self-efficacy belief • Prospective science teacher • Teaching process

* This study is adapted from a doctoral dissertation which was presented at Marmara University in 2011.

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The variables that form a system must be taken into special account for that system to function. The proper functioning of variables that create a system is possible through regular analysis and through improvement of the variables. Education systems also emphasize the basis of teachers, students, and programs. A malfunction or deficiency in any of these hinders the function of the education system. A system that functions effectively depends on harmony among these factors. This study analyzes one of the basic variables of the education system: the harmony between self-efficacy beliefs of future prospective science teacher and their teaching practices.

Bandura (1986) stated that self-efficacy, which is the basis of Social Learning Theory (1977), is related to self-judgments about how well an individual can perform the actions that are required for coping with possible situations. Additionally, the expectations of people in certain situations largely depend upon their judgment of self-efficacy (Bandura, 1986). Kuzgun (2003) stated that self-efficacy belief is a result of an individual's capacity, achievements, motivations, and other components that form self-awareness; it indicates whether the next behavioral attempt will initiate a behavior, or if an already initiated behavior will continue (as cited in Bıkmaz, 2006).

Banduras' (1986, p. 25) statement, "People act on their thoughts and feelings," identifies the relationship between human ideas and behavior; it reveals how effective self-efficacy belief is on an individual's behavior. Numerous researchers have agreed that self-efficacy belief is important in individuals' lives, particularly when deciding to perform certain behaviors, as is the case in several belief fields such as attitude, trust, motivation, and perception (Gordon, Lim, McKinnon, & Nkala, 1998; Pajares, 1992; Tschannen & Woolfolk-Hoy, 2002). It has been emphasized that individuals spend more effort and are more motivated and resistant towards difficulties in situations in which they have high self-efficacy belief when compared to those with lower self-efficacy beliefs. On the other hand, individuals with lower self-efficacy belief might perform poorly and be less resistant to negative conditions; this might cause them to leave things unfinished (Gordon et al., 1998; Pajares, 2002).

Self-efficacy in teaching should also be taken into account, as should teachers' knowledge and skills in teaching through an effective application of curriculum. Studies on improving teacher qualities have pointed out that teachers must be aware of their own effectiveness (Çakır, 2004). Teachers' self-efficacy beliefs have been suggested to be able to significantly affect their classroom practices, particularly their teaching, opinions and tendencies to realize teaching, teaching environments (Ashton & Webb, 1986), and efforts to teach (Bandura, 1986; Pajares, 2002). Studies on teachers' self-efficacy beliefs (Ashton, 1984; Gibson & Dembo, 1984; Ramey & Shroyer, 1992) have suggested that teachers' self-efficacy beliefs have a considerable effect on their teaching style, classroom behavior, openness to new

ideas, and development of new teaching attitudes. In the literature, teachers with high self-efficacy are believed to be able to enhance student motivation and help them raise their success levels through consideration of students' needs and adoption of a student-centered approach (Ashton & Webb, 1986; Tschannen-Moran et al., 2002; Woolfolk, Rosoff, & Hoy, 1990). On the other hand, studies have emphasized that teachers with lower self-efficacy beliefs adopt teacher-centered approaches and prefer surrendering to trivial problems, instead of resisting them (Allinder, 1994; Gordon et al., 1998; Martin, 2006; Milner, 2002; Plourde, 2002).

In addition to the opinion that beliefs shape actions, there are also experts who think that beliefs do not influence or shape actions (Lyons, 1990; Tobin, Tippins, & Gallard, 1994). Similarly, in addition to the opinion that self-efficacy beliefs are effective in teacher's teaching practices (Nespor, 1987), experts exist who think that beliefs can be shaped after teaching practices (Shulman, 1986). Therefore teaching determines what questions to confront, such as how effective self-efficacy is in teaching, to what extent is it reflected in teaching, and how accurately can teachers and prospective teachers evaluate their self-efficacy beliefs (Azar, 2010; Tschannen-Moran et al., 2002).

There have been a great number of studies in the literature on the self-efficacy of teachers and prospective teachers. These studies can be seen to mostly be aimed at detecting the self-efficacy beliefs of teachers and prospective science teachers in just one field, and their data was collected through scales of teaching self-efficacy in various fields through quantitative analysis methods. Many studies in Turkey have focused on whether the gender of teachers or prospective science teachers causes a difference in self-efficacy levels (Berkant, 2013; Gerçek, Yılmaz, Köseoğlu, & Soran, 2006; Özgen & Dinbak, 2011; Özsoy-Güneş, İnce, & Kırbaşlar, 2015) by using a self-efficacy scale (Akkoyunlu & Orhan, 2003; Aksu, 2008; Kahyaoğlu & Yangın, 2007; Uysal & Kösmen, 2013), or focusing on whether the effects of class level (Akbulut, 2006; Ay & Yurdabakan, 2015; Berkant, 2013), diverse fields (Akbaş & Çalıkkaleli, 2006; Aydın, Ömür, & Argon, 2014; Kahyaoğlu & Yangın, 2007), or their academic success level made any difference in their self-efficacy. In addition, these studies aimed to obtain information through open-ended questions and interviews, and the information obtained through these data have involved teachers' self-conceptions and have even involved how they would like to view themselves. Therefore, no study was seen to identify the extent to which teachers' teaching beliefs reflected their teaching practices or the degree to which they were in harmony.

Based on the situations mentioned above, this study is thought to have importance by evaluating what can be performed for prospective science teachers to improve by determining the relationship between science teaching self-efficacy beliefs and their teaching practices, as they will be a part of the teaching process in the future.

Accordingly, the problem stated in this study is generated with the question: How are the teaching practices of prospective science teachers who have different levels of science teaching self-efficacy belief?

Method

The case study, a qualitative research design, was used for the purpose of examining the teaching processes of prospective science teachers with different levels of science teaching self-efficacy beliefs. In qualitative research, because social phenomena are formed in their natural settings, it is common to make sense of the outcomes of research only in their natural setting, to understand every event within its own setting, and to evaluate the events, as well as obtain and interpret the findings, in this context (Bogdan & Biklen, 1992; Denzin & Lincoln, 1994; Patton, 1987). In this research, the qualitative research design was preferred in order to deeply interpret and examine the thoughts and behaviors of prospective science teachers with different levels of science teaching self-efficacy beliefs toward the teaching process.

Study Group

The sample group was comprised of four prospective science teachers in their final year of the science teaching department. To determine the study group, the Science Teaching Efficacy Belief Instrument (STEBI) was applied to 125 prospective science teachers in their final year of a state university. According to the results obtained from the instrument, critical case sampling (a type of purposive sampling; (Patton, 1987) was used in the research with four prospective science teachers who had different self-efficacies. The average instrument score was calculated as 85.15 at the beginning of the study, according to the analysis that was performed after the application of STEBI. This value was set as the criteria. According to the average score, the sample group was selected from "volunteer" prospective science teachers by giving information about the research to determine the case study group. At the beginning of the research, six prospective science teachers were chosen: two prospective science teachers from the group with the highest self-efficacy, two prospective science teachers from the group with the lowest self-efficacy, and two from the group with average self-efficacy. However, while the application process of the research was in progress, one of prospective science teacher in the low self-efficacy group had to leave the research. As each case study was analyzed in itself and then compared to the others, because one of the prospective science teachers with low self-efficacy had left, one of the prospective teachers with high self- efficacy also needed to be excluded, based on the opinion of three experts. Therefore, the research was conducted with four prospective teachers. While presenting the findings conducted from these four prospective science teachers, the researcher used different names to keep their identities confidential. Demographic information for the four prospective science teachers is presented in Table 1.

Table 1
Demographic Information of Prospective Science Teacher in the Case Study

Self-efficacy Level	Scale Score	Naming	Gender	Age	GPA
Lowest	46	Murat	Male	22	2.69
Below Average	84	Melike	Female	22	3.04
Above Average	86	Elif	Female	23	3.08
Highest	104	Ayşe	Female	22	2.91

Data Collection Tools

In this research, STEBI was used in order to measure the levels of self-efficacy belief of prospective science teachers and also select the sample group for the case study. The data obtained from the observations, interviews, and documents were collected to ascertain the teaching processes of the four prospective teachers with respect to the results of the STEBI from the beginning of the research.

Science Teaching Efficacy Belief Instrument (STEBI). STEBI was used in this study to measure the self-efficacy beliefs of prospective science teachers. This scale was developed by Riggs and Enochs (1990), and it was adapted into Turkish by Özkan, Tekkaya, and Çakıroğlu (2002). It includes 23 items of the 5-Likert-type scale. The instrument has two parts: the personal science teaching efficacy belief (PSTE), which expresses one's beliefs in their ability to realize a job, and the science teaching outcome expectancy (STOE), which describes one's expected behaviors. The PSTE scale includes 13 items and the STOE includes 10 items. Cronbach's alpha reliability value was found as .76 by Riggs and Enochs, while Özkan, Tekkaya, and Çakıroğlu (2002) found the value to be .83. In this study, Cronbach's alpha value was found as .87.

Observation. Bailey (1982) asserted that the observation method should be used to comprehensively present the behaviors that emerge during the investigated subject, as well as to detail how they developed over time. The types of observation are classified as structured or unstructured and participant or non-participant observations (Creswell, 2013; Merriam, 2013; Patton, 2015). The unstructured participant observation method was used in this research. Thus, the researcher carried out the observations of prospective teachers' behavior and instructions off to the side without interfering in their activities. During the research, the four prospective science teachers were observed while they applied teaching in the classroom. The instructions were recorded by a camera for reference later on to assure validity issues during analysis.

Interview. Two semi-structured interviews were performed in this study. The first one required both answers from the prepared alternative questions, and it was aimed to acquire deep information on the subject. The other interview was prepared before the interview by the researcher, and required answers with partial flexibility from the participants (Patton, 1987; Yıldırım & Şimşek, 2004). One interview was performed

before the teaching practices, and the other was conducted at the end of these practices. When faced with a contradiction in the process of analyzing the data, the prospective science teachers were re-interviewed. These interviews were also recorded to prevent them from getting lost during data analysis. In the first interview with prospective teachers, questions were asked, such as their opinion on the basic notions of teaching, their plans about how to lead the teaching process, and their feelings on whether they were competent for the lessons. In the last interview, the questions asked to the prospective science teachers were about their self-evaluation of the lesson they gave. As seen in the following questions, what they experienced during the lesson and how competent they were during their teaching were attempted to be determined.

Documents. Written data such as diaries, letters, field notes, and essays are important data sources for both quantitative and qualitative researches. In most research types that use case studies and grounded theory, the documents, observations, and interviews are used together to strengthen the quality of the research (Ekiz, 2003; Punch, 2005). The documents from this study included the written materials that had been prepared beforehand for teaching the lesson and the lesson plans that had been prepared by the prospective science teachers for their teaching applications.

The Process of Applying the Research

At the beginning of the research, the science teaching efficacy scale was applied to 125 prospective science teachers who were in their final year of a state university. Twenty minutes were allowed for the candidates to answer the 23-item scale. Four prospective science teachers were chosen to present their teaching processes according to the scale results (see *Study Group*). After the selection process, the first interview was performed, focusing particularly on the pre-teaching process of the prospective teachers. Following the interview, prospective teachers were included in the teaching program of the schools where they had already been teacher trainees. They were asked to teach a related subject. Before they applied their teaching, prospective teachers had a chance to experience instructing. Prospective teachers were told that they were free to develop the teaching experience of the unit, and they would be given material and resource support during their application. The subject was "Matter and Heat" for 6th graders, and four prospective teachers were asked to teach the same subject so they could be compared equally. While the prospective science teachers were developing their teaching applications, the researcher observed them and video recorded the whole process. The last interview about their experiences during the research was then performed with the prospective teachers after having watched their lesson recordings. In the study instrument, triangulation was established so as to reduce the impact of potential individual bias (Merriam, 1988; Patton, 1987; Patton, 2014). In this way, the consistency of results was determined and the internal

reliability of the research was achieved. Research data gathered was shared with the participants in order to ascertain the social validity of the implementation. In line with the qualitative paradigm, participant confirmation like this refers to internal validity (Lincon & Guba, 1985). Details were given while presenting the research findings in the study so as to maintain the external validity of the research (Lincon & Guba, 1985; Merriam, 1988). Additionally, reliability was attempted to be maintained across the researchers during both data collection and data analysis (inter-rater reliability). In doing so, external reliability was expected to be achieved.

Data Analysis

The quantitative data obtained by STEBI was analyzed using the SPSS 13 program. After calculating the mean values and standard deviations, the prospective science teachers' science-teaching self-efficacy belief levels were determined. The analysis of the four prospective teachers' teaching practices, which had been selected by considering their results from the scale, was done using the content analysis method for discovering themes, as developed by Strauss and Corbin (1990). Using content analysis, the data was attempted to be described to discover the hidden situations (as cited in Yıldırım & Şimşek, 2004). In this regard, the content analysis method was used to analyze data obtained by the in-class observations, interviews, and documents.

Before analyzing the observations, interviews, and documents, the researcher transcribed the video and sound recordings of the observations from the lessons and interviews into a Microsoft Word document. Points that had not been noticed during the recording and interview processes were taken into consideration, then two experts who had already studied in this field examined and corrected them. The documents, which were the other data source, were directly assessed because they had been written. The basic dimensions that had been obtained from the results of the literature through the research question were examined, and codes and sub-codes were formed (Grossman, 1990; MEB, 2008; Nilsson, 2008; Park & Oliver, 2008; Shulman, 1998; Şişman, 2009). Themes were then formed by adopting an inductive approach (Patton, 2015). The findings were interpreted by organizing data according to these codes and themes. With the intent of supporting the findings and interpretations of the research analysis (Merriam, 1998), direct quotations, excerpts from observations, anecdotes, interviews, and documents from the application process were utilized.

Findings

As a result of data analysis, the teaching processes of the four prospective science teachers with varying self-efficacy levels were evaluated by comparing them to one another. The results of this evaluation were presented in two dimensions: *lesson* preparation and teaching *application*.

Lesson Preparation

One of the important stages of the teaching process is preparing for the lesson. Preparations of the prospective science teachers were both similar and different from each other. On one hand, the four prospective science teachers were seen to have similar ideas on how to perform a good teaching session as per the interviews that had been performed before the teaching process.

Researcher: Who is a teacher?

Ayşe: A teacher is a consultant according to current understanding. I can define a teacher as a guide who shows the way to students. *I've really thought it over and I've adopted the constructivist approach. It's necessary. When you teach and teach all the time, students get used to taking with no effort. They begin to wait for knowledge because it is given them. Now we see that's not the right way. The teacher is the guide*.

Researcher: Well, what do you think about effective teaching?

Elif: I think effective teaching should raise students' awareness as well as be their guide.

Researcher: What if we say effective science teaching?

Elif: *…when we talk about effective science teaching, we always emphasize science literacy, bla bla. But the point is to make them really acquire it. While we* do *this, we have to do it not randomly but consciously.* For instance, you cannot apply every method to any subject, and there is no obligation to use more than one method while you teach a specific subject. If we know which method to use to better teach a subject, or what kind of exercises to use for different grade levels, and if we use audio-visual materials while teaching, we can effectively apply science teaching. Effective teaching achieves its goal especially when students use classroom knowledge in their daily lives.

Melike: …If I were a student and the teacher constantly said "Review these things at home," I definitely wouldn't learn. I have to be taught in class. *The teacher should be clear enough to teach the subject in class and shouldn't let me learn just by studying at home. They should teach according to my needs and learning style.*

…both being enjoyable and involved, sometimes being serious, as in teaching the subject, but more than anything, effective teaching should be done by associating it with something…

…At first, we have to know the students and teach how they would like to learn. We shouldn't say "I will teach like that, or you should teach like this."

Researcher: How best can learning be realized from the students' perspective?

Murat: I think students learn better when the subject that is taught is *appealing them*, draws *their attention*, *and* uses *different teaching techniques*.

As seen from the comments, prospective science teachers were gathered around the ideas that the teacher should be a guide, teach according to the levels of the students and use different learning ways. All prospective science teachers agreed that teaching practices enriched with different methods and techniques and applied as to the learning way of students enable effective learning. In general, whereas having different levels of self-efficacy, prospective science teachers adopted the student-centered modern approaches.

In preparation of lesson section, it was observed that there were individual differences in using student's book among prospective teachers. As seen below, the candidate who has the highest self-efficacy level preferred to use only course book by thinking the teacher's book is adequate enough. On the other hand, the rest of the candidates used different sources while prepared for the lesson.

Researcher: What kind of a planning did you do while preparing the lesson? What issues were your priorities?

Ayşe: I was prepared using teacher's book. I tried to use teacher's book mostly. The activities part of the book was quite good, so I preferred to use it.

The prospective teacher with the lowest self-efficacy took advice from the teacher in school on different practice examples, and also used the course book and source books that included examples of questions similar to the general exams organized by Ministry of National Education. Melike and Elif were observed to try and make use of various source books in addition to the course book more than the other two prospective teachers in terms of preparing materials and performing the applications during the teaching process. They did more research than the others did.

Table 2
Sources Used By Teachers While Preparing The Lesson Plans and Their Competences on Preparing Lesson Plans

	Murat	Melike	Elif	Ayşe
Sources	Course book, guide books	Course book, guide books	Course book, guide books	Course book
Planning	partly adequate	partly adequate	Quite adequate	partly adequate

As seen in Table 2, prospective teacher Elif behaved most meticulously in preparing her plans by taking every detail into account. She prepared by considering every stage of practice for the in-class activities. Although the other prospective teachers had also prepared their lesson plans, they were found to have tried making general plans. Nevertheless, these prospective teachers prepared little notes for their idiosyncratic teaching processes, yet they did not write them down in the lesson plans. These findings were expressed in the post-teaching interviews.

Researcher: Did you apply the relevant steps during your teaching practice?
Ayşe: *When you said "plan," I had already made a list of 10 items,* such as introduction to the lesson, making personal introductions, etc. I even wrote to ask students how they are.

Researcher: Did you write these points into your lesson plan?
Ayşe: *I didn't, but I wrote them on my own stuff.* Just to remember, I crossed out the items on the list as I did them. It stems from a lack of experience. This should be something normal and natural. But if I did not write them, I would forget. So I preferred to take notes. I suppose I won't need to do these things with time.

Researcher: What kind of a planning did you do while preparing for the lesson? What issues were your priorities?
Melike: At first, I looked in the teacher's book about what should be emphasized and what should be taught. Then the question became how can I make this lesson more enjoyable? There were many activities in the book, but I looked at various reference books, thinking that maybe I could find activities that were more enjoyable. Then I wrote them on a paper as: I should explain this here, give their homework there, make them write these things, etc. I made my lesson plan like this.

As seen from the comments, the prospective teachers tried to detail what they should do at every step in their notes, yet they did not write them in their lesson plans in a planned or organized way. In general, apart from Elif, who had an above-average self-efficacy level, the prospective science teachers could be said to need to improve themselves in planning lessons.

Teaching Process

As was indicated in the previous chapter, the prospective science teachers had asserted before the teaching applications that teaching should be done with a student-centered approach. However, differences were observed between their discourses and applications. In Table 3, prospective teachers' general approaches to teaching and the teaching process can be seen.

Table 3
Prospective Science Teachers' *Teaching Approaches Adopted Before and Applied During* the *Teaching*

	Murat	Melike	Elif	Ayşe
Adopted teaching approach	Student-centered	Student-centered	Student-centered	Student-centered
Applied teaching approach	Teacher-centered Student-centered	Student-centered Teacher-centered	Teacher-centered Student-centered	Teacher-centered Student-centered

In Table 3, we can see that even though all four prospective teachers seemed to use both student-centered and teacher-centered approaches, there were differences in terms of frequency and application. While Melike used both student-centered and teacher-centered approaches in the beginning, she was observed to teach in a more

student-oriented manner over time. The other prospective teachers tried to use student-centered and teacher–centered approaches together. When Elif and Ayşe encountered difficulties with some situations while teaching, they were found to mainly focus on the teacher-centered approach.

Another point to be highlighted is that the prospective teachers started their teaching processes using the question and answer method. Using this technique enabled prospective teachers to understand students' preliminary information, to prepare them for the new subject, and to let them know about the things they would learn. Murat, Melike, and Elif were also noted to give examples from daily life and tell interesting stories in order to draw attention. Ayşe, who had the highest self-efficacy level among all the prospective teachers, wanted students to read the introduction part of the book to let them know about the objectives.

After giving introductions, all prospective teachers were observed to try using many methods, such as experiments, role-plays, analogies, and examples from daily life. Melike especially often used modern approaches, such as cooperative learning and project activities for teamwork. All prospective teachers tried to do experiments related to the subject. However, Ayşe tried to do all the experiments only for show. Among the prospective teachers, Melike was seen to be the only one who made students do the experiments on their own. Although all prospective teachers tried to use many methods and techniques, they did not achieve all the teaching processes to the same degree. In particular, the prospective teacher with the highest self-efficacy level could not achieve student acquisition of some of the predetermined goals. For instance, thinking that she could not realize the teaching, Ayşe said "Maybe I should have focused on teaching the subject" as can be seen from the comments.

Researcher: Primarily, what did you notice?

Ayşe: I basically tried to do more activities because I thought that when students see examples, they don't forget easily. I tried to ask them more questions. It's all the same. I watched it from different videos. I thought that maybe I should have focused on teaching the subject. It seemed to me that I expected everything from them (after watching the video records). I don't know.

The results of the observations showed that Ayşe frequently asked the students questions, but when she didn't get an answer from one, she would get an answer from students who had prior knowledge of the subject. The students who answered the questions in the dialogues had acquired the information from private courses or private teaching institutions. Ayşe was also seen to apply the activities more visually. She prepared notes about the information to be acquired and gave them to the students whom she thought had not learned from the previous lesson.

Researcher: You gave notes to the students at the beginning of the second lesson. Why did you do that?

Ayşe: Why? I spent all my time teaching the subject, and there were many questions. I was not sure if every student had understood or not. I tried to make them take notes, but some took notes so slowly, and others might not care about what I'm saying, I wasn't sure. They didn't pay attention to taking notes, therefore I wanted to give them the details of the subject. I tutored a student once, I saw it there. He was haphazardly taking notes. He didn't even know what he had written in his notebook. There's almost no information in the books provided by the Ministry of National Education. At least they will learn the activities we did in class. I wrote every activity and explanation. I also wrote the core of the subject.

Researcher: Well, when you start teaching… (Ayşe interrupts here)

Ayşe: I will do the same thing. This will not be something burdensome. Do not think that she did this just because of her eagerness. There will be three different classes, so it won't be so hard to prepare these sheets for just one subject. You just copy it. Therefore, I'm going to do this; I think it will be beneficial.

Regarding her comments, Ayşe said that she had prepared the sheet, both assuming that her students didn't like taking notes and that it made it easier for the students to study and review the subject. She also plans to do the same in future.

Having above average self-efficacy, Elif tried to guide the students' attention to the lesson and create an environment which enabled students to be more active during the lesson. However, she had a hard time maintaining the students' motivation and keeping them interested in the subject.

Researcher: in the previous interviews. You had stated in preparing the lesson plan that you had had difficulty motivating the students at the beginning of a lesson. Did you experience such a thing in this study?

Elif: Well, I think I can get the students' attention in the beginning. I always tell stories at the beginning of a lesson, like, I tell them that... *Oh, but the problem is keeping them motivated during the lesson.* I have difficulty, but not much.

In the observations that were performed during the teaching practices, Elif's problem was found to stem from following the prepared lesson plans and trying to apply them without taking the needs of students into consideration. This prospective teacher also explained that she intended to ensure self-learning at the same time. She stated that her lesson plans were the most important indicator of this issue, because Elif frequently emphasized that she would always follow her plans strictly.

Researcher: Did you apply the approach adopted by the program?

Elif: I was quite insistent about its application. I am not sure about how successful I was at teaching, but I did all my programs according to it. I tried not to tell the students things

like "This is it." I always asked them, waiting to hear key words from them. That's the way I prepared my plans. I tried to hear these things from each student. For example, I asked them to write their deductions after the experiments. Some of them wrote unrelated things. Others wrote as I expected, using the key words. I thanked those students immediately and asked them to read it again. Or I told the students "Your friend wrote better. Complete your sentences using those." I tried hard to do this. … For instance, I concluded the subject with a definition after having completed all the activities, which I think is a must. I tried to use the constructivist approach.

Nevertheless, preparing a plan convenient to the adopted approach does not mean that it should definitely be applied. Regarding Elif's comments and observations, she can be said to have encouraged the students do self-learning. However, the expression "*...your friend wrote better, complete your sentences using those*" indicated that the candidate did not intend to make every student learn. Even though Elif tried to use modern teaching processes, she often used teacher-centered methods.

Among all of the prospective science teachers, Melike was the only one who used the student-centered approach during teaching. Melike tried to keep the students' attention alive, and she enabled them to learn by asking questions and being aware of what they did while doing experiments and activities. In the interviews done before and after the teaching applications, Melike stated that she had given the greatest importance to this issue, and the planned and applied parts of the lesson were observed to be in harmony.

Melike: … I do not expect them to remember everything I have taught, but I want them to remember clearly what they do remember. For example, when they see an apple falling, they should ask "Why did the apple fall?" and answer it. … *I would like them to use their knowledge in daily life. Even if they don't remember everything, I want the things they do remember to enable them to at least relate to real life.*

Researcher: Do you think you have applied sufficient methods and techniques?
Melike: Yes, I applied various things.

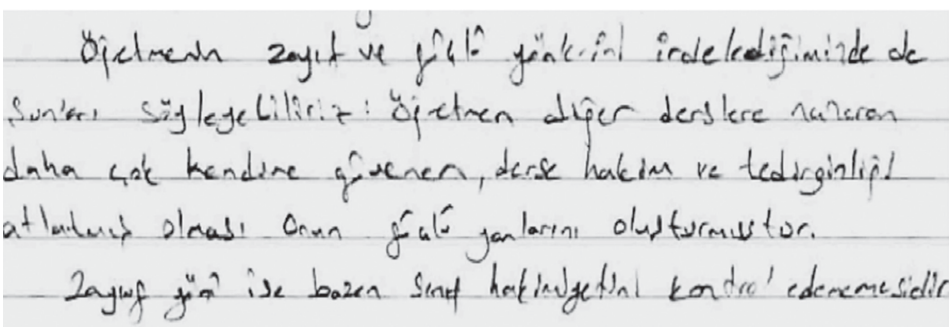
Researcher: Did these methods and techniques serve their purposes?
Melike: They definitely did. They learned the experiments. Subjects should be taught with the support of activities and experiments. Therefore, I did. In some situations I made them discuss the subject by brainstorming. I assumed they would learn better. So, I think the techniques and methods were effective.

Melike was also the most successful prospective teacher to enable the students to form their facts and notions by creating convenient environments for them. Melike pointed out in the post-teaching interview that she had tried to materialize the lesson in order for it to be better understood; to accomplish this, she used the experiment method. She said that in this way, the students learned easily. As stated before the

teaching applications, Melike also created environments where the students could be more active and learn with fun. Both the observations done by researcher and the comments from the students in class showed that they were quite content.

The other prospective teacher, Murat, tried to make students more active. He got their opinions by asking questions to let them to be aware of the subject during his teaching practices. He also made them think and drew their attention. Sometimes he summarized the subject with students, and sometimes he did it himself. This prospective teacher was seen to use numerical examples when necessary while teaching. In the pre-teaching interviews, he had said "…science is not an easy lesson. It is harder than math. In math, you can see students' progress a bit more clearly. When you have a good command of the subject, you feel comfortable and more self-confident. You can say that I know everything about this subject." As understood from his comment, he tended to teach the subjects that he felt competent and confident about. His content knowledge and attitudes towards the subject can be said to have had an effect on his teaching practices. However, in the pre-teaching interview, he had stated that he would not be quite successful in the least.

Researcher: What are your opinions about your teaching performance?
Murat: In general, it was better than I expected.



"When we examine the strengths and weaknesses of a teacher, we can say the following things: a teacher should be more confident and competent when comparing other lessons; one should feel comfortable enough to teach. These are a teacher's strengths. Weakness is to sometimes lose control of the class." (Translation of his comment)

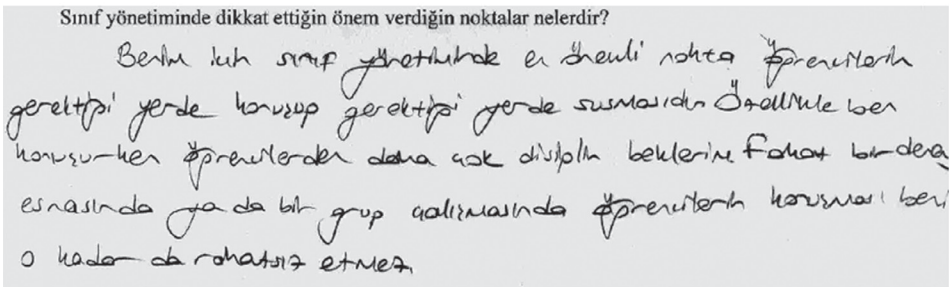
As seen above, this prospective teacher performed his teaching application more effectively than he had expected to. Even though he was uneasy at first while teaching, he later became more comfortable.

The general structure of the classroom management is shown in Table 4. In classroom management, Melike had the least difficulty whereas Elif had the most difficulty.

Table 4
Classroom Management Approaches Applied by the Prospective Science Teacher

	Murat	Melike	Elif	Ayşe
Classroom management approach	Traditional, Preventative	Developmental, Holistic	Traditional, Reactive	Traditional, Preventative

When comparing the prospective teachers in terms of classroom management, Elif was found to be the most authoritative. She stated in the pre-teaching interviews that she had preferred the teacher-centered approach and when she lost authority, she preferred to use the punishment method.


Sınıf yönetiminde dikkat ettiğin önem verdiğin noktalar nelerdir?

"(For students), talking and being silent when necessary is the most important point of classroom management for me. I expect to be more disciplined while I am talking. But I do not disturb them if they talk in a group activity or in an experiment." (Translation of her comment)

Researcher: What do you think that you should do with mischievous students? How do they affect you?

Elif: … if the student interrupts the lesson too often, there is a method we read in our books called "standing silent in the corner." I send him/her to one of the corners of the class and say "You will not turn your face towards your friends." I would make him/her stand there 4-5 minutes. I'll then ask, "Will you do it again? If so, you have to wait here until the end of lesson." Usually they get the point, but if not, I make jokes like "you talk too much, let's color your face with chalk." They say, "Aww, no teacher, nooo way!"… I've experienced something like this. I warned him several times and the silent corner did not help us. Finally, I asked the classmates, "What kind of a punishment do you want?" The students went crazy and began shouting "Death! Death!" They were 6th graders. He got surprised and thought "I disturbed them by talking much." But that was only for that lesson. The following lesson, the student had returned to his old behavior.

As seen in the pre-teaching interview, Elif had managed class using different punishment methods such as "standing silent in the corner" to isolate a student who had interrupted the class. She applied these punishments while conducting this research. One of the interesting points in Elif's quote is that she knew the punishments were useless from her experience with them. When these techniques did not help her, she turned to the classical method: when she talked about a subject, the students were asked to write what she said.

The prospective teacher with the highest self-efficacy had difficulty, though not as much as Elif. The post-teaching interviews done with Ayşe showed that she also had had difficulties while teaching due to the problems she had faced in classroom management:

Researcher: What does classroom management mean to you?

Ayşe: It is something hard, I see, because every student marched to a different tune. Their characters are different. When you tell a student "Please do not do this," but they don't care and do it anyway, it's hard to control them.

Researcher: What are your thoughts on classroom management? How should it be? How would you describe good classroom management?

Ayşe: For instance, I noticed that they don't respect each other. I didn't like it. They argued too much. If I were their teacher, I would definitely have prohibited it. Maybe I should have done it by shouting at them. I didn't, but I should have done it somehow.

In the post-teaching interviews, she evaluated her teaching process, highlighting "to be silent when the teacher talks" and "respect." She mostly taught by standing near the board. When she wanted to wander among the students, she failed to do this fully because she focused only on one or two students when she tried. While she was busy with those students, the rest of the class began to do other things irrelevant to the lesson, losing their attention and interest in the lesson. The other problem that she was observed with was having difficulty with time management. She usually dismissed the classes earlier than planned. She used the remaining time for extracurricular activities.

Melike stated in the post-teaching interviews that, whereas she should have accomplished some of the requirements in classroom management, she could not do some of them. She mainly focused on creating comfortable settings to enable the students to take an active role and also get them to express themselves, as seen in her comments:

Researcher: Did you enable the students' to have active participation?

Melike: Sure. I heard all the students more than once. Sometimes I forced them to talk, but I integrated all of them into the lesson.

Researcher: Do you think you have created a democratic setting?

Melike: In some cases, I couldn't. There were some students who were so active and talkative. Süleyman, for example, talked in every lesson. I was not successful enough. It was because I didn't want to dishearten the students who wanted to participate. Besides, I don't know exactly how to treat them. Some of the students talked five times, some talked twice. Therefore, I might not have treated them equally. I do not want to force students to participate in case they lose their self-confidence.

According to observations done by the researcher, this prospective teacher did not have any serious problem in classroom management. She created the setting that aimed to teach all students by using different methods and techniques, and she enabled students to be active and express themselves during the lesson. In particular, she tried to predict the needs of the students and probable problems, therefore she followed a preventive process.

Murat, who had the lowest self-efficacy among the prospective teachers, expressed the following instructions at the beginning of the first lesson regarding classroom management:

> **Murat:** If you are silent during the lesson, we can answer your questions, OK? Being silent means not talking to each other. It does not mean you stay silent all the time. You can ask questions whenever you want just by raising your hand. Then we can answer. I ask you questions, you answer them, and we all can learn better this way.

Murat explained what he expected from the students. While he was teaching, he mainly taught by standing at the lectern, which prevented him from reaching all the students. The observations, interviews, and video recordings presented that Murat was usually excited and sometimes uneasy, especially in the first lessons he gave. This situation affected his classroom management skills. Murat followed a punishment method by marking a minus point for students who did not obey the rules he had explained in the first lesson. When students established positive behaviors or participated in the lesson within a certain time, he later corrected those minuses. He tried to strengthen the classroom management.

For measuring the acquisition of teaching, all prospective teachers generally conducted assessments and evaluations using the question and answer technique during the process. As seen from Table 5, the question and answer technique was often used, yet some prospective teachers used different assessment and evaluation tools and applications.

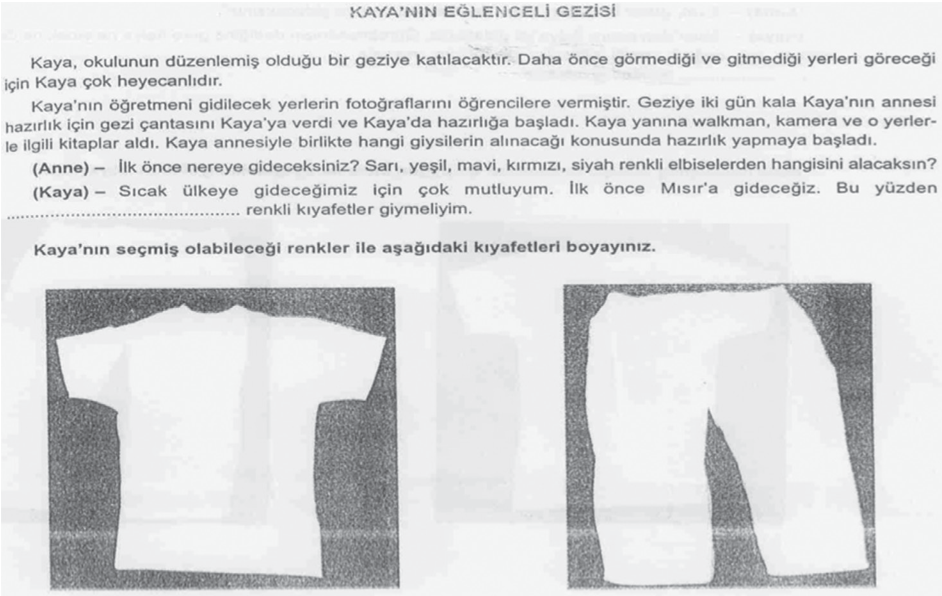
Table 5

Assessment Instructions Used by Teachers During Teaching Processes

	Murat	Melike	Elif	Ayşe
Assessment tools used	True-False Fill-in-the-blanks Oral puzzle	Fill-in-the-blanks, Question-answer, Self-assessment, Matching	Question-answer, Worksheet, Matching , Case study	Question-answer True-False Fill-in-the-blanks Multiple-choice test
The level of assessment tools	Knowledge- comprehension level	Advanced cognitive skills	Knowledge-comprehension-practice	Knowledge- Comprehension

Elif, who had the above-average self-efficacy level, prepared alternative assessment tools in addition to questions and answers within the teaching process. However, Elif was observed to give these tools to students as homework, and she did not evaluate them to see whether they had understood the subject or not. Below, there is a sample from the assessment tool that Elif prepared:

Melike, who had the below average self-efficacy level, applied alternative assessments, such as the V-diagram, what do I know, and what did I learn, as well as the project evaluations in accordance with the purposes. Using source books for preparing the lesson plan, Murat also used these questions during the application process.


KAYA'NIN EĞLENCELİ GEZİSİ

Kaya, okulunun düzenlemiş olduğu bir geziye katılacaktır. Daha önce görmediği ve gitmediği yerleri göreceği için Kaya çok heyecanlıdır.

Kaya'nın öğretmeni gidilecek yerlerin fotoğraflarını öğrencilere vermiştir. Geziye iki gün kala Kaya'nın annesi hazırlık için gezi çantasını Kaya'ya verdi ve Kaya'da hazırlığa başladı. Kaya yanına walkman, kamera ve o yerlerle ilgili kitaplar aldı. Kaya annesiyle birlikte hangi giysilerin alınacağı konusunda hazırlık yapmaya başladı.

(Anne) – İlk önce nereye gideceksiniz? Sarı, yeşil, mavi, kırmızı, siyah renkli elbiselerden hangisini alacaksın?

(Kaya) – Sıcak ülkeye gideceğimiz için çok mutluyum. İlk önce Mısır'a gideceğiz. Bu yüzden .... renkli kıyafetler giymeliyim.

Kaya'nın seçmiş olabileceği renkler ile aşağıdaki kıyafetleri boyayınız.

Kaya's Fun Trip

Kaya will participate in a trip organized by the school. Kaya is very excited to go and see places she had never seen before. Kaya's teacher gave the students photographs of the places they would visit. Two days before the trip, Kaya's mother gave her a travel bag to be prepared, and she began to prepare Kaya. Kaya got her walkman, camera, and books about the places. Kaya together with her mom began to prepare which clothes she would take.

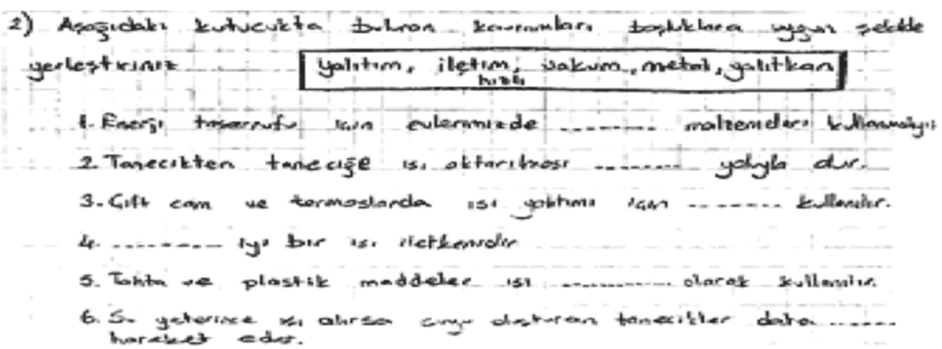
(Mother)- Where will you go first? Which clothes will you take, the yellow, green, blue, red, or black ones?

(Kaya)- I'm so happy that we're going to a hot country. We'll go to Egypt first, so I should wear my ....colored clothes.

Color the clothes with the colors Kaya could have chosen.

Figure 1. A sample from the assessment tool prepared by Elif, who had above-average self-efficacy and its translation.

Besides these applications that were performed during teaching, all prospective teachers apart from Elif consolidated the lesson at the end of the teaching process. In her assessment, Melike prepared an exam that evaluated advanced cognitive skills more than the other prospective teachers' exams did; Murat used puzzles, true-false, and fill-in-the-blanks; and Ayşe used true-false, matching, and multiple-choice tests. All prospective teachers prepared questions mainly by measuring knowledge and comprehension levels. Below is a sample from questions prepared by Ayşe, and Melike:

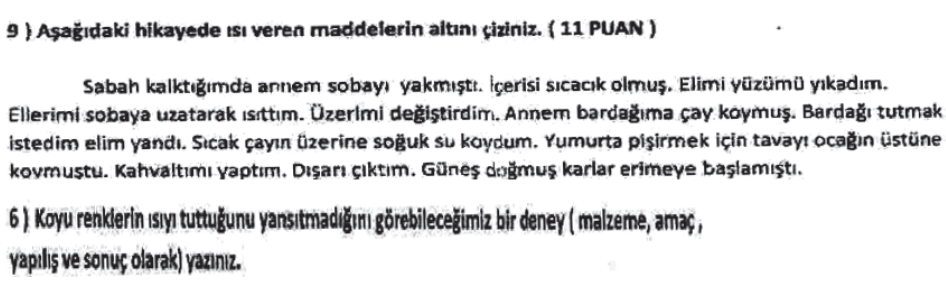

2) Aşağıdaki kutucukta bulunan kavramları boşluklara uygun şekilde yerleştiriniz.

Yalıtım, iletim, vakum, metal, yalıtkan

hızlı

1. Enerji tasarrufu için evlerimizde .... malzemeler kullanmalıyız
2. Tanecikten taneciğe ısı aktarılması .... yoluyla dır.
3. Çift cam ve termoslarda ısı yalıtımı için .... kullanılır.
4. .... iyi bir ısı iletkenidir.
5. Tahta ve plastik maddeler ısı .... olarak kullanılır.
6. S. yeterince ısı alırsa sıvıyı oluşturan tanecikler daha ...... hareket eder.

Figure 2. A sample of Ayşe's assessment tool, who had the highest self-efficacy.


9) Aşağıdaki hikayede ısı veren maddelerin altını çiziniz. (11 PUAN)

Sabah kalktığımda annem sobayı yakmıştı. İçerisi sıcacık olmuş. Elimi yüzümü yıkadım. Ellerimi sobaya uzatarak ısıttım. Üzerimi değiştirdim. Annem bardağıma çay koymuş. Bardağı tutmak istedim elim yandı. Sıcak çayın üzerine soğuk su koydum. Yumurta pişirmek için tavayı ocağın üstüne koymuştu. Kahvaltımı yaptım. Dışarı çıktım. Güneş doğmuş karlar erimeye başlamıştı.

6) Koyu renklerin ısıyı tuttuğunu yansıtmadığını görebileceğimiz bir deney (malzeme, amaç , yapılış ve sonuç olarak) yazınız.

Figure 3. Two sample of Melike's assessment tools, who had below and above average self-efficacy, respectively.

Generally speaking, both similar and different applications of assessment and evaluations were seen to be conducted by the candidates. The prospective teachers who had lowest and highest self-efficacy beliefs were found to not be significantly different. Also, two other prospective teachers, Elif and Melike, were determined to have prepared their assessment and evaluation tools oriented towards alternative and advanced cognitive skills. When it came to apply and evaluate these tools, Melike was the most successful teacher candidate.

Discussion, Conclusion, and Suggestions

Bandura determined that human behaviors are based on what people believe to be true rather than what the case is in reality (1997). This is a very important distinction. People usually may have the opinion that their self-efficacy beliefs are lower or higher than they really are. Starting from this point, the results of the measurements to determine self-efficacy beliefs were solely based on people's comments about their self-perceptions. In this sense, the results of this case study, which was formed according to the results obtained from the science teaching self-efficacy scale and carried out on four prospective science teachers, showed that they had different levels of science teaching self-efficacy beliefs, as indicated below, with the aim of better ascertaining how they perform teaching.

In the interviews conducted before the teaching process, the four prospective teachers could be seen to have similar thoughts on teaching, on the need to have students at the forefront of teaching, and on performing teaching coherently through contemporary approaches. This finding shows that prospective teachers' teaching beliefs were not different even though they possessed different levels of science-teaching self-efficacy belief. The absence of a significant relationship between beliefs on teaching and the pedagogical knowledge of prospective chemistry teachers in the study conducted by Oskay, Erdem, and Yılmaz (2009) also shows consistency with the current study. Obtaining different levels of teaching belief can be seen to not have made any difference in terms of general pedagogical knowledge. All four prospective teachers who participated in the study could be seen to have the opinion that teachers should teach in a reified way without assuming only the role of an

information transmitter. However, the lack of constant harmony between thoughts and practices was also observed when the applications were examined. Akkoc and Bekiroglu (2006), who analyzed the relationship between beliefs towards learning and teaching and the practices of prospective teachers, put forward that the statements of some prospective teachers were coherent with their practices, as was the case in this study, and some prospective teachers presented completely opposite profiles. Additionally, despite the fact that the teachers who participated in this study stated that they had adopted the student-centered approach, the commentary of teachers with a high level of self-efficacy who adopted the teacher-centered approach (as they themselves remarked as the most determinant role in teaching practices; Crippen, 2008) can explain the behavioral patterns of the prospective science teachers with high-levels of self-efficacy who participated in this study.

While the prospective teacher with the highest level of self-efficacy stated they had adopted student-centered approaches before the teaching processes, this teacher predominantly used the presentation strategy. The other three prospective teachers preferred using presentation, in addition to finding other strategies. However, all prospective teachers applied all of the subject experiments and tried to implement various methods. Among the prospective teachers, those that had average levels of self-efficacy belief in science teaching tried to apply the greatest numbers of methods, especially Melike. She was the below-average scorer who became the most student-oriented prospective teacher through her application of process-oriented methods, such as cooperative learning and doing projects differently than other prospective science teachers. The prospective science teacher that had the highest self-efficacy belief score proceeded with applying the presentation method, which was inefficient for students that generally used the activities for visual purposes. Therefore, no correlation could be stated between the prospective teachers' self efficacy beliefs and their teaching activities. In the study results of Gerges (2001), a relationship between the self-efficacy beliefs of prospective teachers and their diversity of teaching methods could not be found. Gerges (2001) specified that when the prospective teachers chose their teaching method, what was particularly efficient, aside from their self-efficacy belief, was the subject of the course, level of the students' development and skills in the class, and prospective teachers focus on the subject and knowledge of teaching.

From the point of view of the assessment and evaluation, prospective science teachers could be seen to frequently apply the question and answer technique in their teaching process. In addition, the prospective teachers who prepared the most complete assessment and evaluation tools during the teaching process had the average levels of self-efficacy. However, Elif, who had an average level of self-efficacy, did not give these prepared tools as an assignment, nor did she evaluate, whereas Melike applied them relevantly by preferring alternative tools that included process evaluation,

in accordance with the assessment and evaluation approach. Additionally, all four prospective teachers paid attention to performing assessments and evaluations at the beginning and end of the classes. At the end of the unit, three prospective teachers, excluding Elif with the above-average self-efficacy, carried out a subject consolidation. Of these three prospective teachers, only the questions prepared by Melike, who had self-efficacy at a below-average level, measured the more advanced skills when compared to the other two. These other two, on the other hand, asked their questions at the level of knowledge and comprehension. Consequently, the generalization that teachers or prospective teachers with high levels of self-efficacy belief aim for higher mental skills more than others is not considered to be accurate. The study Lardy (2011) carried out attained the result that some teachers with high self-efficacy levels aimed for higher levels of mental skills from their students while others with the same self-efficacy aimed lower. Accordingly, the study that Li and Yu (2010) conducted also corroborates the results which revealed that along with applying low-level questions in assessment and evaluation, mathematic teachers failed at ensuring the development of high level cognitive skills from the student group they had taught.

When examining the teaching processes of prospective science teachers, the prospective teacher, Melike, who was just below average in self-efficacy, was determined to have performed both teacher-centered and student-centered expressions at the beginning. However, she applied student-centered approaches more frequently as the class progressed. For this prospective teacher especially, experience was observed to present a positive effect. Melike specifically attached importance to teamwork when adopting student-centered approaches, and she ensured effectiveness in teaching by enabling students to express themselves as much as possible. Contradicting the view that low self-efficacy brings low performance, the prospective science teacher with the lowest self-efficacy was observed to try and apply student-centered approaches all throughout the teaching process, which was unexpected. On the other hand, Elif, who had a slightly higher than average self-efficacy, applied both traditional and contemporary approaches together; she especially tried to apply definite teaching methods. Nevertheless, she was seen to behave compulsively while doing this, and sometimes she got undesirable reactions from students by acting insistent, especially about finishing planned activities. On the other hand, the prospective teacher with the highest self-efficacy was seen to try and perform activities that were more relevant to the subject, yet remained insufficient in performing teaching by implementing teaching practices merely to make a difference. As in her comment, "I mostly tried to have students do activities," she performed the activities; however, she could not sufficiently implement the necessities of teaching through activities with the performed activities. In addition, both prospective science teachers that had above average self-efficacy levels experienced difficulty in structuring lesson duration and classroom management. It was observed amongst prospective science teachers, who are the participants of this

study, that those with high self-efficacy experience less disciplinary problems, which puts forward results that affect the quality of teaching in a positive way, such as trusting and respecting the teacher (Pehlivan, 2009), whereas the opposite situation affects teaching in a negative way. The correlation of approach with high self-efficacy, success, and motivation of students can be indicated accordingly by different learning forms, and creating an environment that facilitates learning is not always effective (Caprara, Barbaranelli, Steca, & Malone, 2006; Gibson & Dembo, 1984; Midgley, Feldlaufer, & Eccles, 1989; Ross, 1992, Woolfolk, Rosoff, & Hoy, 1990). Also, these prospective teachers were observed to attribute the problems they had faced with the application to the students. According to the results presented in the study by Southerland et al. (2010), prospective teachers with high levels of self-efficacy were not seen to hold themselves responsible when faced with unexpected situations; also, the fact that teachers with high self-efficacy levels were not observed to exhibit greater diligence or resistance because they had attributed the problems to their students as opposed to what was expected shows parallels with the results of this study.

However, unlike the prospective science teachers that had self-efficacy at the highest and lowest levels, the teaching performances of those with an average efficacy level were observed to differ from each other. While Melike, whose self-efficacy was slightly below average, exhibited positive behaviors with a constant, involuntary critical perspective, Elif, who was just above average, exhibited low performances from time to time and showed behaviors towards giving up. In the moment of performing the teaching application, the prospective teacher with below average efficacy exhibited a more successful performance. The results obtained in the studies of Uludağ (2005) and Shawer (2010), which examined the relationship between self-efficacy belief and performance, support the results obtained in this study. Uludağ (2005) observed that the teaching beliefs of prospective teachers did not affect their teaching practices in the results of the study she carried out to analyze the relationship between the teaching beliefs and practices of nine prospective teachers. Also in correlation was the survey conducted by Shawer (2010), which revealed that teaching beliefs do not cause changes in teaching skills.

In light of the results obtained from the current case study, the accuracy of interpreting high levels of self-efficacy as causing high-performance teaching or, conversely, interpreting low levels of self-efficacy in teaching as causing low-performance teaching was not clearly manifested. In consequence of this study, prospective science teachers with self-efficacy beliefs at the lowest and highest levels were observed to exhibit completely contradictory performances. When considering their teaching practices, these results show that individuals do not act objectively enough in self-assessment. The findings obtained through the survey were in harmony with the results from the studies carried out by Ladner (2008) and Li and Yu (2010). Ladner (2008) put forward

that the relationship between mathematic teachers' self-efficacy beliefs and their teaching practices did not present itself adequately in his research. What is interesting is that even though the knowledge level of teachers was good, they were not efficient at putting their knowledge into practice. These results showed that the teachers followed the curriculum but did not add anything new to it; they completed their teaching process while the students did not complete their learning processes. The attained results were observed to correspond with the practices of the teachers with self-efficacy at the highest level. By accepting that teachers' training is a complicated process of suppressing inconsistency, enhancing practices towards knowledge and reflecting knowledge is suggested. Walker (1992) also analyzed the harmony between prospective teachers' self-efficacy beliefs and their teaching practices. The data acquired from the prepared measures and observation forums were compared with each other according to such standards as applying different teaching methods, enabling students to perform their routine assignments, showing concern for students, observing student development, abiding by school policies, and keeping students' files in order. As a consequence of the comparisons, prospective teachers happened to perceive themselves at a higher level of performance as a result of the evaluations of practice teachers. Therefore, prospective teachers can be seen to evaluate themselves different than how they really are.

There are arguments in the literature that assert teachers' beliefs are a complicated process. Beliefs have been suggested to be changeable with effort over time (Nespor, 1987). Kagan (1992) suggested that teacher beliefs do not change easily, and inexperienced teachers in particular should be supported in career development during the process. Teachers' awareness should first be raised, then the newly acquired information and experiences should be integrated with these beliefs. Lastly, they need to be tested. According to the study conducted with primary school teachers, Lardy (2011) stated that high self-efficacy does not always mean high performance, and low self-efficacy does not always mean low performance; as the results have shown, it is actually a complex process. Therefore, instead of making this kind of generalization, it is recommended that the objective self-evaluation skills of teachers and prospective teachers should be developed. In addition, not just scales or questionnaires, but observation and interview techniques are also recommended as data collection tools that should be used in studies that aim to determine or measure beliefs such as self-efficacy. In order to evaluate themselves more objectively, teachers and prospective teachers should develop both self-evaluation and peer-evaluation skills by using the microteaching method during their training. This study is deficient in the sense that it only observed how prospective teachers' learning process improves or diminishes in those that were in their final year of the university. Therefore, in order to look over the development of teachers themselves, as well as the instructors within the process, it is recommended to conduct the evaluation process throughout their education.

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