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Examination of the Self-Efficacy Beliefs of Prospective Chemistry Teachers in terms of Different Variables (The Sample of Dokuz Eylul University)*

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Abstract

This research was conducted to adapt the chemistry self efficacy belief (CSEB) scale using Confirmatory Factor Analysis (CFI) and to examine pre service teachers' CSEB in terms of some demographic features. This descriptive study was carried out Dokuz Eylul University in 2008-2010 academic years. Firstly, for validity and reliability, the scale was administered to 123 prospective chemistry teachers. In order to determine CSEB according to some variables which are gender, class level, type of high school, and giving lecture, the scale was implemented 116 prospective chemistry teachers. LISREL 8,71 and SPSS statistical programs were utilized to analyze the collected data. It was confirmed whether CSEB scale has two factors or not by calculating fit indexes. Independent and ANOVA t-tests were used to outline if there was a significant difference between self efficacies of prospective teachers according to gender, class level, type of high school and giving lecture. The results of confirmatory factor analysis showed that fit indexes values were found high and verified structure of the scale with two factors. According to the results of second research question, there was no significant difference between gender and class levels, but there was a significant difference between type of high school in favor of Anatolian teacher high school.

Key Words

Self-efficacy, Confirmatory Factor Analysis, Prospective Teacher, Demographic Features.

Self-efficacy belief is of paramount importance in the transfer of the information and skills that prospective teachers acquire during their prospective education to the students (Brooker & Service, 1999; Turley, 1999). In the literature, self-efficacy belief is defined as the self-confidence of an individual for having the skill necessary to fulfill the requested behavior, the continuity in a given task and efforts that are exerted (Kinzie, Delcourt, & Powers, 1994; Senemoğlu, 2002). According to Bandura (1977) who conducted significant studies on self-efficacy belief, this concept assumes that environmental and personal factors are mutually interactive and deterministic in enabling an individual to perform a certain behavior and to obtain the desired result. As beliefs, expectations and targets of the individuals determine their behaviors, results of these behaviors also shape their personality characteristics. Even though self-efficacy belief and the outcome expectancy are completely different structures, according to Bandura (1997, p. 79), individuals with a high self-efficacy belief can obtain the results that they desire and thus, the outcome expectancies are shaped accordingly. It is presumed that people with high outcome expectancies and self-efficacy belief levels behave more decisively and confidently. In their study concerning the teacher efficiency and self-efficacy, Gibson and Dembo (1984) determined that there was a linear relationship between the self-efficacy belief and teacher efficiency in the teachers and beliefs of the teachers in their skills became a factor resulting in the individual differences in terms of efficient teaching.

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According to Bandura (1986), self-efficacy beliefs which lead to individual differences are influenced by mastery experiences, vicarious experiences, verbal persuasion and stress reduction. Studies conducted so far showed that the most influential factor on the self-efficacy belief was mastery experiences (Akkoyunlu & Orhan, 2003; Bandura, 1986; Cantrell, Young, & Moore, 2003; Ginns & Waters, 1999). Self-efficacy belief of an individual whose mastery experiences were diverse is stronger and thus, his/her motivation and success levels are higher. According to Brand and Wilkins (2007), self efficacy beliefs often improve with an increasing number of years of experience. So, they found that mastery experiences were the most influential in prospective teachers' teaching self-efficacy beliefs. Besides, observing the experiences of other people can also contribute to the development of self-efficacy belief. In this process, the individual takes into consideration such characteristics as age, education level and/or sex while acquiring the qualifications observed in the successful individual. According to Pajares and Valiante (1999), the more similarities individuals see between themselves and the individuals that they take as model, the higher their self-efficacy levels become. Except for mastery and vicarious experiences, verbal assessments stating that the individual has certain skills also influence the self-efficacy belief. While positive incentives and positive class participation encourage the individual to believe in his/her own skills, negative assessments weaken the self-efficacy belief (Bandura, 1986). Positiveness of emotional trends displayed in a positive setting also has a positive impact on the self-efficacy belief and enables the individuals to express their teachings more freely (Bandura, 1986).

Some other studies emphasize that mastery experiences and thus, previous science experiences and sex of the individuals are important as well as the above-mentioned factors affecting the self-efficacy belief (Anderman & Young, 1994; Andre, Whigman, Hendrickson, & Chambers, 1999; Dalgety & Coll, 2006; Mulholland, Dorman, & Odgers, 2004; Pajares, 1992; Riggs, 1991). Morgil, Seçken and Yücel (2004) examined the relationship between self-efficacy belief in chemistry teaching and sex in a study conducted on prospective chemistry teachers and detected that male prospective teachers had higher self-efficacy beliefs than the female prospective teachers included in the study. Although the quantitative scales were used in many studies related to the factors affecting teaching self-efficacy beliefs of prospective teachers, some studies in recent years have been utilized qualitative research (Ashton & Webb, 1982; Berman & McLaughlin, 1977; Büyükduman, 2006; Carrier, 2009; Ekinci, Vural, & Hamurcu, 2008; Gibson & Dembo, 1984; Henson, 2001; İşler, 2008; Ritter, Boone, & Rubba, 2001).

When these factors affecting the self-efficacy belief were considered, it was determined that it was necessary to see and explain how the self-efficacy belief changed in the course of time and which factors affected this change. Besides, Küçükyılmaz and Duban (2006) recently emphasized the importance of investigating the self-efficacy beliefs in the specific fields.

Purpose

At the first phase of the study, validity and reliability of the chemistry teaching self-efficacy scale which was developed by Riggs and Enochs in 1990 and changed as "chemistry" instead of "science" by Rubeck and Enoch (1991) were examined. The exploratory factor analysis (EFA) was primarily conducted because there were many studies using this scale which had different number of items and whether it kept the authenticity or not (Bıkmaz, 2004; Özkan, Tekkaya, & Çakıroğlu, 2002). EFA is described as exploratory if the researchers have theoretical questions about underlying structure and they have no idea about number of factors which are consisted of numerous items (Byrne, 1994; Şekercioğlu, 2009). After EFA, confirmatory factor analysis (CFA) is used to verify of two factor structure of scale. CFA allows the researcher to test the hypothesis that a relationship between variables (Büyüköztürk, 2007; Green, Salkind, & Akey, 1997; Maruyama, 1998). CFA is very useful for the development of measurement tools, organization and revision work (Floyd & Widaman, 1995). Second purpose of the research was to determine the self-efficacy belief levels of the prospective chemistry teachers studying at chemistry teaching departments and to indicate whether their self-efficacy belief levels differ according to the sex, class level, type of the graduated high school and the lecturing time.

Method

Research Design

First phase of the research was to test the reliability and validity of the Self-Efficacy Scale developed by Riggs and Enochs (1990) and adapted to Turkish by Özkan, Tekkaya, and Çakıroğlu (2002). Second phase of the study was a relational survey model revealing whether there was a significant difference between variables. This research investigated

whether there was a significant differentiation in the sub-dimensions of the self-efficacy belief with regards to the class level, sex, type of the graduated high school and lecturing time variables of the prospective chemistry teachers.

Universe and Sampling

Research universe was composed of prospective teachers studying at the Department of Chemistry Education while the sampling consisted of 2nd, 3rd, 4th and 5th grade prospective teachers studying at the Department of Chemistry Education in Dokuz Eylül University. 123 prospective teachers studying at this department in the 2008-2010 academic years participated in the study for the validity and reliability analyses of the scale while 116 prospective teachers studying at this department in the 2010-2011 academic year took part in the research to determine the relationship between the self-efficacy belief levels of the prospective teachers and their demographical features. 61.2 % of the participants were female (n=71) and 38.8 % of them were male (n=45). In the sampling, the rates of the 2nd, 3rd, 4th and 5th grade prospective teachers were 32,8 % (n=38), 17,2 % (n=20), 25 % (n=29) and 25 % (n=29), respectively. 36.2 % of the participants were graduates of general high school (n=42), 27,6 % of them were graduates of Anatolian High School (n=32), 14,7 % of them were graduates of Anatolian Teacher High School (n=17), 12,1 % of them were graduates of Vocational High School (n=14) and 9,5 % of the participants were graduates of Super High School (n=11). When the periods that students gave private lessons or worked in a private course were examined, it was found out that 58,6 % of them never worked (n=68), 30,2 % of them worked for a period between 0-6 months (n=35), 6,9 % of them worked for a period of 6-12 months (n=8) and 4,3 % of them worked for a period of 12-24 months (n=5).

Instruments

Personal Information Form: Personal information form consisted of the independent variables including sex, class level, type of the graduated high school and the lecturing time, which are thought to influence the chemistry teaching self-efficacy belief of the prospective chemistry teachers included in the sampling.

Self-Efficacy Belief Scale for Chemistry Teaching: Original form of the chemistry teaching self-efficacy scale which was developed by Riggs and Enochs in 1990 and changed as "chemistry" instead of "science" by Rubeck and Enoch (1991) were used to determine the self-efficacy belief levels of the prospective chemistry teachers about teaching the chemistry course. This scale was used by some researchers putting the "mathematics" and "biology" words instead of the word "science" (Dede, 2008; Gülev, 2008). Chemistry teaching self-efficacy belief scale consisted of 25 items. 13 of these items measure the personal self-efficacy belief while 12 of them measure the outcome expectancy. Chemistry teaching self-efficacy belief scale is a relative likert type scale and it has a scoring ranging from 1 (Strongly disagree) to 5 (Strongly agree).

Data Analyses

It was determined at the beginning that sampling size was sufficient for the validity and reliability studies of the scale, it met the normality assumption, there was no single and multiple outliers and there was not also loss and extreme values (Çokluk, Şekercioğlu, & Büyüköztürk, 2010; Tabachnick & Fidell, 2001). KMO value was calculated as 0.78 and it was concluded that it was "reasonably sufficient". Besides, when the results of the Bartlett sphericity test were considered, it was observed that the obtained chi square value was significant ($\chi^2 = 1107.63$; df=300; $p< 0.01$). Accordingly, it was accepted that the data were obtained from the multivariate normal distribution. Principal components analysis was used to reveal the factor pattern of the chemistry teaching self-efficacy scale and varimax upright rotation method was employed as the rotation method. At the end of analyses, it was observed that there were 2 components over eigenvalue 1 among the 25 items basically constituting the analysis. Contribution of these components to the total variance was 38.08 %. In the literature, acceptance level was determined as 0.32 for factor loading values in the exploratory factor analysis (Kline, 2005). In the analysis conducted for two factors, items were evaluated whether the interlace and factor loading values met the acceptance level and it was found out that one item was interlaced and the three items were below the acceptance level, 0.32. After removing these four items scale structure included two factors was examined with confirmatory factor analysis (CFA).

In order to test the structural model of scale included two factors with CFA, many goodness of fit statistics have been produced and the most popular among these are; goodness of fit index (GFI), adjusted goodness of fit index (AGFI), comparative fit index

(CFI), normed fit index (NFI), non-normed fit index (NNFI), incremental fit index (IFI), relative fit index (RFI), root mean square error of approximation (RMSEA) and root mean square residual (RMR). Except RMSEA and RMR, these return values between 0 and 1, and values over 0.90 indicate an acceptable goodness of fit (Kelloway, 1989; Kline, 2005; Lei & Wu, 2007; Schermelleh-Engel, Moosbrugger, & Müller, 2003; Schumacker & Lomax, 1996; Shevlin & Miles, 1998; Sümer, 2000; Şimşek, 2007; Tabachnick & Fidell, 2001). However, in RMSEA and RMR, values lesser than 0.05, prove a good fit value, when values below 0.08 show an acceptable goodness of fit (Hoe, 2008; Hooper, Coughlan, & Mullen, 2008; Hu & Bentler, 1999; Jöreskog & Sörbom, 1993; Steiger, 2007; Sümer, 2000; Thompson, 2004).

When modification suggestions concerning the results obtained at the first CFA were examined, it was realized that associating the error covariances of item 3 and item 8 would cause a significant decrease in $\chi 2$ value of the model and error covariances of two items were associated. Based on the fitness indices belonging to the last model, it was accepted that the model displayed a sufficient fitness. Figure 1 shows the CFA model of the two-factor self-efficacy scale.

It was understood that the chemistry teaching self-efficacy scale preserved its two-factor structure in the original form by considering that the t values of the observed variables were significant, error variances were not very high and the fitness indices were at the desired levels. In terms of the reliability studies of the scale, Cronbach alpha coefficient of the total scale was calculated as 0.82. However, it was determined as 0.81 for the outcome expectancy sub-scale and 0.86 for the personal self-efficacy sub-scale. Since Cronbach's alpha coefficient which is an indicator of homogeneity among scale items is between 0.60-0.80, it proves to be a very reliable instrument (Alpar, 2003; Kayış, 2008).

At the second phase of the study, individual differences between the prospective chemistry teachers were investigated and they were analyzed with t test. The effect of sex was examined through the independent t-test while ANOVA t-tests were used to find out whether there were significant differences between class level, type of the graduated high school, lecturing time and the chemistry teaching self-efficacy belief.

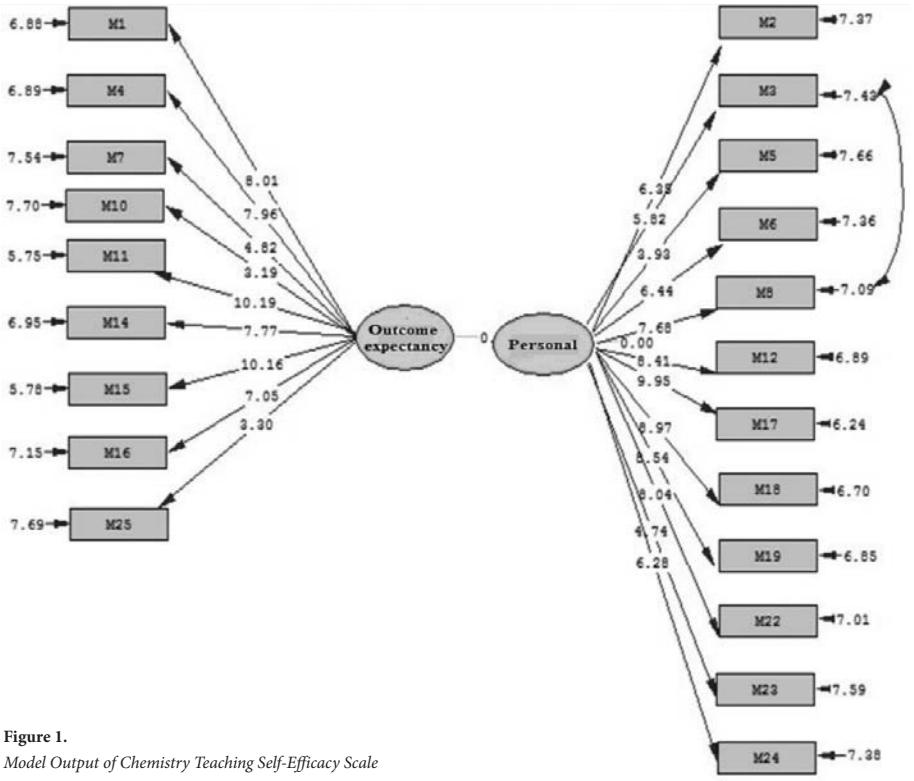

Figure 1.
Model Output of Chemistry Teaching Self-Efficacy Scale

In the comparison of arithmetic means of the likert type scale, the formula of "Gap Width = (Row Width) / (The number of groups to be formed)" was used for the grading scale, pentad scale intervals were divided into equal intervals at a rate of 0.80 (5-1 = 4 4/5 = 0.80) and score intervals were determined (Gökdaş, 1996, p. 21; Tekin, 1996). Answers of the prospective teachers to each item were assessed in three categories as high, medium and low level by considering the score intervals.

Findings

What was the Level of Self-Efficacy Beliefs of the Prospective Chemistry Teachers Concerning the Chemistry Teaching?

Total score average of the outcome expectancy sub-scale of the chemistry teaching self-efficacy belief scale was 31.43 and the standard deviation value was 3.77. This value showed that self-efficacy beliefs of the prospective teachers about the chemistry education were above the medium level and they agreed on the items in the outcome expectancy sub-scale of the self-efficacy scale (score interval = 3.49). On the other hand, total score average of the personal self-efficacy sub-scale of the chemistry teaching self-efficacy belief scale was 49.51 and the standard deviation value was 5.31. Thus, it can be concluded that personal self-efficacy beliefs of the prospective teachers concerning the chemistry teaching were good and they agreed on the items listed in the personal sub-scale of the self-efficacy scale (score interval =4.12).

Did the Self-Efficacy Beliefs of the Prospective Teachers about the Chemistry Teaching Display Significant Differences in terms of the Sexes of the Prospective Teachers? According to the results of the independent t-test, outcome expectancy sub-scale of the self-efficacy beliefs of the prospective teachers about the chemistry teaching scale did not differ significantly by the sex ($t(114)=0.92$, $p=0.35>0.05$). Besides, no significant difference was detected in the personal self-efficacy sub-scale ($t(114)=-204$, $p=0.83>0.05$).

Did the Self-Efficacy Beliefs of the Prospective Teachers about the Chemistry Teaching Display Significant Differences with regards to their Class Levels? According to the results of the single factor variance analysis (One-Way ANOVA) for the unrelated samples, personal self-efficacy beliefs of the prospective teachers about the chemistry teaching did not display significant differences in terms of their class levels ($F(3-112)=0.97$; $p=0.40>0.05$). Likewise, a significant difference was not found between the outcome expectancy sub-scale of the chemistry teaching self-efficacy beliefs and the class levels of the participants ($F(3-112)=0.23$; $p=0.86>0.05$).

Did the Self-Efficacy Beliefs of the Prospective Teachers about the Chemistry Teaching Display Significant Differences with respect to the Type of the Graduated High School of the Prospective Teachers? According to the results of One-Way ANOVA, a significant difference was observed between the personal self-efficacy sub-scale of the chemistry teaching self-efficacy beliefs of the prospective teachers scale and the type of the graduated high school of the students ($F(4-111)=3.82$; $p=0.04<0.05$). Accordingly, prospective teachers graduating from the Anatolian teacher high schools had more positive personal self-efficacy beliefs when compared to the prospective teachers graduating from the general high schools and the vocational high schools. Likewise, there was a significant difference between the outcome expectancy sub-scale and the type of the graduated high school of the students ($F(4-111)=5.13$; $p=0.01<0.05$). Accordingly, outcome expectancy beliefs of the prospective teachers graduating from the Anatolian teacher high schools, Anatolian high school and general high school were more positive than those of the prospective teachers graduating from the vocational high schools.

Did the Self-Efficacy Beliefs of the Prospective Teachers about the Chemistry Teaching Display Significant Differences in terms of their Lecturing Times? It was determined that there was a significant difference between the prospective teachers who never worked and those working for 0-6 months and 6-12 months in terms of the chemistry teaching personal self-efficacy sub-scale. Besides, it was also detected that the prospective teachers who never worked displayed significantly different outcome expectancy from those working for 0-6 months and 12-24 months. At the same time, a significant difference was also observed between the outcome expectancies of the prospective teachers working for 0-6 months and those working for 12-24 months. This difference is in favor of the working prospective teachers and shows parallelism to the personal self-efficacy sub-scale when assessed in terms of the working students.

Discussion

In the first step of the research, reliability and validity of the chemistry teaching self-efficacy scale

developed by Riggs and Enochs (1990) were examined and the last version of the scale consisting of 21 items was obtained.

When self-efficacy belief levels of the prospective teachers about the chemistry teaching were considered, they were found at upper-medium level for the outcome expectancy sub-scale and at high level for the personal self-efficacy subscale. While the "outcome expectancy" which is defined as the ability to estimate the results of the behaviors is largely acquired by vicarious experiences, the "self-efficacy belief" defined as the belief of a person as regards to whether s/he can display the required behavior successfully is acquired through the mastery experiences. Mastery and vicarious experiences which are the most influential factors on the self-efficacy levels of the prospective teachers require a person to have a strong self-efficacy. Considering this point, prospective teachers within mastery and vicarious experiences are said to have upper-medium and good personal self-efficacy beliefs. Beliefs of the prospective chemistry teachers included in the research to perform certain behaviors successfully were high. As a matter of fact, it is emphasized in the literature that individuals with high self-efficacy levels can achieve the desired results and the outcome expectancies are shaped accordingly (Bandura, 1977).

According to the findings of the research, neither personal self-efficacy beliefs nor outcome expectancies of the prospective teachers studying at the department of chemistry education did not differ in terms of sex. Even though this result contradicts with the result revealed by Morgil et al. (2004) revealing that there was a significant difference between both variables, it shows parallelism with the results obtained by other researchers (Akbaş & Çelikkaleli, 2006; Altunçekiç, Yaman & Koray, 2005; Oğuz & Topkaya, 2008; Yaman, Cansüngü & Altunçekiç, 2004). With the increase in the number of women taking part in the education, education levels increased and in parallel to this, the culture also changed and more responsibilities were given to the women in the professional life. Thus, it can be concluded that the number of educated women is almost equal to the number of educated men and, in turn, an academic identity and self-confidence developed in women. As their education levels increase, women have more important roles in the education and acquire the self-efficacy necessary to assume the responsibility of a profession. Bandura (1997) assumed that the self-efficacy increases with the duties and responsibilities. Consequently, lack of a significant difference in the self-efficacy level in terms of sex can be attributed to these factors.

It is obvious that there is not a significant difference between the two sub-scales of the self-efficacy beliefs scale in terms of the class levels of the prospective chemistry teachers. This finding contradicts with some studies (Çalışkan, Selçuk & Özcan, 2010; Gülev, 2008; Kahyaoğlu & Yangın, 2007) which assert a significant difference in terms of learning levels but shows parallelism with the findings of Gerçek, Yılmaz, Köseoğlu, and Soran (2006). This finding can be associated with the fact that mastery experiences as an important factor affecting the self-efficacy belief largely depend on the school practices and they have not experienced these yet. It is a fact that mastery experiences where individuals are active participants, struggle against the difficulties on their own, try to reach to results through different ways and there is a process revealing the individual constructivist practices increase both self-confidence and self-efficacy of the prospective teachers. This finding is supported by a suggestion of Tosun (2000) that low self-efficacy levels of the prospective teachers were caused by the deficiency of preparation programs. It is thought that field-related experiences offered to the prospective teachers and the opportunities repeated for success can reduce the effects of many unsuccessful attempts and thus, can increase the self-efficacy belief regarding the education (Bandura, 1986; Tschannen-Moran, Hoy, & Hoy, 1998). Furthermore, the Public Personnel Selection Examination that prospective teachers have recently encountered increases their anxiety about being teacher and reduce their interests towards the school. Therefore, courses related to school experience and teaching taken in this process during which prospective teachers can live mastery experiences that may contribute to their self-efficacy beliefs do not become effective and beneficial and self-efficacy beliefs of the prospective teachers are negatively affected. Woolfolk and Hoy (1990) expressed that prospective teachers should live mastery experiences at schools in recent years efficiently and internalize teaching during this time. Thus, they can increase their self efficacy beliefs. As a result, if mastery experiences are not lived or lived inefficiently, this situation can explain that relationship between self-efficacy beliefs of the prospective chemistry teachers and their class levels is not significant.

When the results regarding the difference between type of the graduated high school and the outco-

me expectancy and personal self-efficacy belief sub-scales which were common were examined, it was observed that there was a significant difference between the Anatolian teacher high school and vocational high school. These findings are consistent with the data obtained in the previous studies (Gürol, Altunbaş, & Karaaslan, 2010). Initial targets of the prospective teachers who graduated from Anatolian teacher high schools and adopted chemistry education as a profession and of those who graduated from the vocational high schools, targeted being a scientist or dealing with the practical applications of the chemistry but later, turned towards education concerning the future influenced their self-efficacy beliefs. Although prospective teachers graduating from teacher high schools always made assumptions concerning the performance and efforts that they would show in their profession in the future, expectations of the graduates of the vocational high schools about their professions based on the education system did not come true.

While there was a significant difference between the prospective teachers who never worked and those working for 6-12 and 12-24 months in terms of the outcome expectancies, a significant difference was also observed between the prospective chemistry teachers who never worked and those working for 0-6 months and 6-12 months in terms of the personal self-efficacy beliefs. This situation supports the conviction that individuals should develop strong self-efficacy by living teaching experiences in person (Bandura, 1994). Prospective teachers will overcome their inner conflicts with the difficulties that will encounter during their experiences and the efforts that they will exert, they will adopt the teaching profession and this will reflect to their profession successfully in the course of time. Another reason for the fact that the self-efficacy belief levels of the prospective teachers with less professional experiences were lower than those of the prospective teachers having more professional experiences could be their negative previous professional experiences. Nespor (1987) detected that self-efficacy levels of the prospective teachers were influenced by their decisions concerning the education and classroom environment. According to this, if their experiences make a positive impact, they become more willing to teach but if their experiences make a negative impact, they become less willing to teach. Within this context, positive classroom environments can be created to enable the prospective chemistry teachers to implement the teaching practices and to live mastery experiences in these environments. Moreover, physical conditions including the positive classroom environments where mastery experiences increasing the self-efficacy beliefs of the prospective teachers are lived can be taken into consideration in the future studies.

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