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*Examination of the Teacher Self-Efficacy of Pre-Service Biology and Science Teachers in Terms of Different Variables

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ABSTRACT

The objective of this study is to determine the teacher and academic self-efficacy of pre-service biology and science teachers and to examine of the teacher self-efficacy of pre-service biology and science teachers in terms of different variables (academic self-efficacy, grade level and academic achievement) The study sample consists of 134 pre-service teachers. In the study, we used the Teacher Self-Efficacy Scale (α= .91) and the Academic Self-Efficacy Scale (α= .87). We used descriptive analyses and regression analysis in the examination of the data. As a result of the descriptive analyses, it was determined that pre-service teachers had high levels of teacher self-efficacy ($\overline{X}$= 166,02), academic self-efficacy ($\overline{X}$ = 21,58), and academic achievement ($\overline{X}$ = 3,41). The study results suggest that pre-service teachers have high levels of teacher self-efficacy and levels of academic self-efficacy. Besides, it was observed that the academic self-efficacy made a significant contribution to the prediction of the belief of teacher self-efficacy and the entire model explained 26% of the variance. Since the results point out the academic self-efficacy as the variable predicting the teacher self-efficacy, it makes us think about the necessity for supporting and developing the pre-service teachers to accomplish an academic task during their education.

Keywords: Academic Self-Efficacy; Pre-service Biology Teacher; Pre-service Science Teacher; Self-Efficacy Belief; Teacher Self-Efficacy.

INTRODUCTION

There are many studies in various fields (such as medicine, psychology, education, business) regarding the belief of self-efficacy due to it's determinative effect on behaviors (Schwarzer, 1993; Tschannen-Moran, Woolfolk Hoy & Hoy, 1998; Bursal, 2008; Özdilek & Bulunuz, 2009; Karaduman & Emrahoğlu, 2011, Timur & Taşar, 2013). Self-efficacy is defined as "people's beliefs about their capabilities to produce designated levels of performance that exercise influence over events that affect their lives" (Bandura, 1994,p. 71). Self-efficacy could be handled as one of the basic psychological structures revealing the different behavioral patterns in individuals. Individuals with a high self-efficacy could manage the events better as they have a higher belief in accomplishment (Schultz and Schultz,

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2007). Bandura (1994) emphasizes the features of individuals with high and low beliefs of self-efficacy as follows: Individuals who believe in their own capacity show a tendency to challenge rather than the behavior of avoidance on difficult tasks. A strong sense of self-efficacy enables individuals to be happy and successful. Individuals with a low belief of self-efficacy, on the other hand, show a lower effort against difficulties. Individuals who are suspicious of their own capacity quickly give up once they encounter with challenging tasks and they have a low level of desire and determination to achieve the specified goals. When they encounter with a challenging task, they recall their personal incapacities instead of the thought of "how to overcome that situation successfully". Such individuals think more about the obstacles they will encounter with and their negative outcomes (Bandura, 1994).

Bandura (1994) stated that the self-efficacy belief was influenced by various factors in the theory of social learning and summarized these factors under 4 titles as follows: performance accomplishment, vicarious experience, verbal persuasion and emotional arousal. These resources could determine the highness or lowness of accomplishment beliefs in individuals. The researchers suggest that experiences that are gained by individuals through accomplishments form the greatest effect upon developing a strong belief of self-efficacy (Bandura, 1977; Zimmerman, 2000). Accomplishments enable individuals to develop a positive belief of efficacy. Failures, on the other hand, devastate the belief of efficacy especially when they occur before the formation of a healthy belief of efficacy (Bandura, 1994). While individuals with greater accomplishments in their past experiences have stronger self-efficacy, individuals with greater mistakes have weaker self-efficacy. The second way of developing the belief of self-efficacy is the vicarious experiences, in other words learning based on modelling (Bandura, 1977; 1994). Individuals who realize that they achieve as a result of the efforts of others have increased beliefs of efficacy. Similarly, individuals who see the failure of others due to high efforts have lower beliefs of efficacy. Besides, the persistent attitudes of these individuals regarding making an effort become weaker. Verbal persuasion is the third way for individuals to develop their beliefs of self-efficacy. Individuals who are verbally persuaded regarding the success of a task may show a greater effort. The fourth way of strengthening the self-efficacy is the emotional arousal. Increasing the stress of individuals changes their misinterpretations regarding the physical conditions and their negative emotional tendencies (Bandura, 1994).

Playing a determinative role on the behaviors of individuals, the belief of self-efficacy is among the important features to be emphasized in education, as well. İn education beliefs of teacher and academic self-efficacy are given importance (Tschannen-Moran, Hoy & Hoy., 1998, Yılmaz & Gürçay, 2011; Elias & Loomis, 2002; Zimmerhofer, Heukamp & Hornke, 2006). Beliefs of teacher self-efficacy provide us important information about training teachers, who could fulfill the efficacies of teaching, cope with problems and show both desire and self-devotion. As a matter of fact, the researchers stated that the belief of self-efficacy was multidimensional and was associated with different areas (such as conditions related with education, social conditions, as well as conditions related with development, personal psychology and health) (Schwarzer, 1993; Bandura, 1994; Pajares, 1997).

The studies being conducted emphasize the importance of self-efficacy especially in the efficacy of teachers and the effect of teacher efficacy in terms of both education and learning (Tschannen-Moran, Hoy & Hoy., 1998; Çapa, Çakıroğlu & Sarıkaya, 2005, Yılmaz & Gürçay, 2011). Various studies examining the beliefs of teachers suggest that teacher's belief of self-efficacy shows the belief extent of teachers to believe that they have the capacity of positively affecting the student success and it may explain the personal differences in teacher's activities (Riggs & Enochs, 1990; Enochs & Riggs, 1990; Gerçek, Yılmaz, Köseoğlu & Soran, 2006).

Teacher efficacy is associated with the belief of efficacy in two areas: efficacy of field information and efficacy of pedagogical field information (Koul & Rubba, 1999). The emotion of insufficiency affects the teacher's insufficiency in one of the aforementioned areas. The better comprehension and recruitment of the beliefs of teacher self-efficacy will apparently increase the quality of educational experiences. As a matter of fact, examining the different variables that explain the teacher self-efficacy and their effects could also contribute to the comprehension and alteration of teacher's behaviors regarding the education. In this context, it is required to support teachers in this aspect starting from the pre-service period.

Having a teacher self-efficacy that is required to struggle with problems being encountered during our education may enable us to gain more qualified educational equipment and to succeed in our profession in the future. In that case, it is required to measure the self-efficacy of a teacher and also her/his belief of self-efficacy regarding the accomplishment of an academic work and to examine the relationships between them in order to explain the behaviors of teachers.

The academic achievement of an individual is affected by factors both in the cognitive and affective areas. One of the affective dimensions affecting the academic achievement is the academic self-efficacy (Ekici, 2012). Today, there are tens of concepts derived from self-efficacy. Academic self-efficacy is also encountered as another concept derived from the self-efficacy, which was suggested by Bandura. The efforts and struggles of individuals regarding the difficult situations in education and their academic achievement are considered important. The studies being conducted underline the importance of handling and examining the academic self-efficacy structures of individuals (Wood & Locke, 1987; House, 1992; Elias & Loomis, 2002; Zimmerhofer, Heukamp & Hornke, 2006). The academic self-efficacy being perceived is related with the belief of students in accomplishing an academic task (Solberg, O'Brien, Villareal, Kennel, & Davis, 1993; Zimmerman, 1995). If a student thinks that her/his effort is not sufficient, she/he will be unable to learn sufficiently and try to pass the exams (Zimmerhofer et al. 2006). Witte (2002) suggests that one of the basic reasons for university students to fail in enhancing their education life is their failure of taking precautions to increase their self-efficacy. Various studies indicated that the belief of academic self-efficacy increased the accomplishment of students and was among the important variables in predicting the academic achievement (House, 1992; Vrugt, Langereis & Hoogstraten, 1997; Elias & Loomis 2002; Ferla, Valcke & Cai, 2009).

The possible performance teachers and pre-service teachers could be predicted through the studies of determining and developing the variables affecting teacher's belief of self-efficacy in education. Besides, the pre-service and inservice educational programs could also be reviewed and enhanced in such a way to involve regultions regarding these structures.

The objective of this study is to determine the teacher self-efficacy and academic self-efficacy of pre-service biology and science teachers and to examine of the teacher self-efficacy of pre-service biology and science teachers in terms of different variables. This study will seek answers to the following questions:

1. What are the teacher self-efficacy levels of pre-service biology and science teachers?
2. What are the academic self-efficacy levels of pre-service biology and science teachers?
3. To what extent do the academic self-efficacy, grade level and academic achievement predict the teacher self-efficacy of pre-service biology and science teachers?

METHODOLOGY

a) Research Design

The relational survey method was used in the study in an attempt to determine the academic self-efficacy, grade level and academic achievement variables predicting the teacher self-efficacy of pre-service biology and science teachers.

b) Participants

The participants of the study was selected according to its convenience for researchers. In this context, the study participants consisted of totally 134 pre-service teachers receiving education in three different state universities (68 from the Department of Biology Education and 66 from the Department of Science Education). While the pre-service teachers receiving education in the 3rd grade comprise 42,5% of the study group, the pre-service teachers receiving education in the 4th grade comprise 57,5%. Regarding the pre-service teachers, 82.8% are female and 17.2% are male. 59% of them have a general academic achievement average of 2.00-2.99, whereas 41% have an average of 3.00-4.00.

c) Data Collection Tools

The data collection tools being used in the study consists of the personal information form, which questions the pre-service teachers about their personal information, as well as the Teacher Self-Efficacy Scale and Academic Self-Efficacy Scale.

Teacher Self-Efficacy Scale (TSS): In the study, we used the "Teacher Self-Efficacy Scale", which was developed by Tschannen-Moran and Woolfolk-Hoy in 2001 year and was adapted into Turkish by Çapa et al. in 2005. Involving 24 items, the scale has three lower dimensions as "Student Participation", "Educational Strategies" and "Classroom Management". The scores to be obtained from the scale vary between 24-216. The Cronbach Alpha reliability coefficient of the entire scale is α= .94. The Cronbach Alpha reliability coefficients of the lower dimensions of the original scale are as follows: α= .91 for the dimension of "Student Participation", α= .90 for the dimension of "Educational Strategies" and α= .87 for the dimension of "Classroom Management" (Tschannen-Moran & Woolfolk Hoy, 2001). The scale was adapted into Turkish with 628 pre-service teachers. The Cronbach Alpha reliability coefficient of the entire scale that was adapted into Turkish was α= .93; and it was determined as α= .82 for the dimension of "Student Participation", α= .86 for the dimension of "Educational Strategies" and α= .84 for the dimension of "Classroom Management" (Çapa, Çakıroğlu & Sarıkaya, 2005). The Teacher Self-Efficacy Scale includes 9 gradings from the insufficient to very sufficient. In this study, the Cronbach Alpha reliability coefficient obtained from the entire "Teacher Self-Efficacy Scale" was α= .97. On the other hand, the Cronbach Alpha reliability coefficient obtained from the dimension of "Student Participation" was α= .93; and it was α= .94 for the dimension of "Educational Strategies" and α= .93 for the dimension of "Classroom Management".

Academic Self-Efficacy Scale (ASS): It was stated that the original scale that was developed by Jerusalem and Schwarzer (1981) in German and involved only one dimension showed a significant structure for the academic self-efficacy. Involving 7 items, the scale has 4 points (completely convenient, convenient, less convenient, completely inconvenient). The scores to be obtained from the scale vary between 7-28. The Cronbach Alpha reliability coefficient of the original scale was determined as α=.87. The researchers tested the validity of the scale based on its correlation with some variables like content, logic and psychology (Jerusalem & Schwarzer 1981). According to the results of the adaptation study, it was determined that the number of items in the original scale remained the same in the Turkish

scale and it was unidimensional (Yılmaz, Gürçay & Ekici, 2007). It was also determined that the validity of the scale that was adapted into Turkish supported the data of the original scale. The Cronbach Alpha reliability coefficient of the Turkish scale was determined as α=.79 (Yılmaz, Gürçay & Ekici, 2007). In this study, on the other hand, the Cronbach Alpha reliability coefficient of the scale was determined as α= .70.

Personal Information Form: Personal Information Form being used in the study consists of the form which questions the pre-service teachers about their personal information (as gender, grade level, academic achievement).

c) Data Analysis

The data were analyzed using the SPSS 20.00 statistics package software. In order to determine the descriptive statistics (as mean, standard deviation, skewness and kurtosis) for teacher self-efficacy and academic self-efficacy as well as reliability of scales in the study. We used the Pearson correlation for the analysis of relationships between the teacher self-efficacy levels of students and the academic self-efficacy, grade and academic achievement and conducted the multiple regression analysis to determine the variables predicting the teacher self-efficacy of pre-service teachers.

In the study, we conducted the multiple regression analysis to determine the variables predicting the teacher self-efficacy of pre-service teachers. Before the multiple regression analysis, we checked whether the study data met the assumptions or not. The multiple regression involves assumptions like the sample size, multicollinearity, outlier, normalcy, linearity, homoscedasticity and the independence of the residuals. Regarding the sample size, Tabachnick and Fidell (1996) considered the number of independent variables and presented the following formula; N > 50 + 8m (m = number of independent variables). This study involves three independent variables and the sample size is 134 and since 134 > 74, the assumption of the sample size is met. We calculated the bivariate correlations between the independent variables for the assumption of multicollinearity (See Table 2). Since all the correlation coefficients were lower than 0.70, this assumption was met. The plots of the predicted values of accomplishment data against residuals, as well as normalcy and linearity, homoscedasticity and independence of residuals met the assumptions. No outliers were observed. In this study, the assumptions that are required to perform a multiple regression are met.

FINDINGS

Table 1 shows the descriptive analysis results regarding the teacher self-efficacy and academic self-efficacy of pre-service teachers. As a result of the descriptive analyses, it was determined that pre-service teachers had high levels of teacher self-efficacy ($\overline{X}$ =166,02), academic self-efficacy ($\overline{X}$ = 21,58) and academic achievement ($\overline{X}$ = 3,41).

Table 1. *Results of Descriptive Statistics*

	Teacher Self-Efficacy	Academic Self-Efficacy	Academic Achievement
Arit. Mean	166.02	21.58	3.41
Std. Deviation	29.01	3.20	.49
Skewness	-1.01	.12	.36
Kurtosis	.74	-.71	-1.89
N	134	134	134

Pearson Product-Moment Correlation analysis was conducted to display the relationship between the teacher self-efficacy levels of students and the academic self-efficacy, grade and

academic achievement. Table 2 shows the results of the Pearson correlation analysis, which was performed between the teacher self-efficacy and variables (academic self-efficacy, grade and academic achievement). A positive, moderate and significant relationship was determined between the teacher self-efficacy and the academic self-efficacy, which signifies that the increase of the academic self-efficacy will positively affect the teacher self-efficacy. However, no significant relationship was determined between the teacher self-efficacy and the grade and academic achievement of pre-service teachers.

Table 2. *Pearson Correlation Coefficients between the Variables*

	Academic Self-Efficacy	Grade	Academic Achievement
Teacher Self-Efficacy	.50**	-.04	.07
Academic Self-Efficacy		-.02	.07
Grade			.35**

In the multiple regression analysis, the academic self-efficacy, grade and academic achievement were handled as variables predicting the teacher self-efficacy. The dependent variable is the teacher self-efficacy. Table 3 shows the results of the multiple regression analysis. The results show that the academic self-efficacy explains 26% of the teacher self-efficacy and is considered the predicting variable (R^2=0.26, F (3,130) = 14.84, p= 0.00). Among three independent variables, the academic self-efficacy was statistically significant at the level of 0.05; however, the class and accomplishment were excluded from the model. There is a positive relationship between the teacher self-efficacy and academic self-efficacy. This finding shows that the academic self-efficacy is the variable predicting the teacher self-efficacy. Thus, the teacher self-efficacy increases in parallel with the increase of the academic self-efficacy.

Table 3. *Multiple Regression Analysis regarding the Teacher Self-Efficacy*

Model		Beta	T	Sig.
1	AcademicSelf-Efficacy	.49	6.52	.000

The study results suggest that grade and academic achievement remain incapable in explaining the teacher self-efficacy and are unable to predict it.

DISCUSSION

The study results show that biology and science pre-service teachers have high levels of teacher self-efficacy and academic achievement (See Table 1). In other words, this result shows that pre-service teachers could arrange the required behaviors in order to achieve their educational goals. The study results suggest that pre-service teachers have high levels of teacher self-efficacy to arrange the behaviors that are required to achieve certain educational goals and high levels of academic self-efficacy to accomplish an academic task. This condition is considered positive as it makes us think that they will have highly qualified and productive activities concerning their profession in the future, as well.

Some studies suggest that there are behavioral differences between teachers with high and low beliefs of self-efficacy in terms of the grade level use of new methods, and giving

feedbacks to students having a difficulty in teaching and learning (Tschannen-Moran & Woolfolk-Hoy, 2001; Özkan et al., 2002). These studies also suggest that teachers with a stronger self-efficacy are more persistent and resistant to learning difficulties compared to weak teachers (Gibson & Dembo, 1984), they become more tolerant towards student's mistakes (Ashton & Webb, 1986) and are more eager to use more teaching methods and teaching materials (Guskey, 1988). Additionally, the researchers state that the high self-efficacy beliefs and high teacher self-efficacy affects the motivation and achievement of students (Schmitz & Schwarzer, 2000; Tschannen-Moran & Woolfolk-Hoy, 2001; Özkan et al., 2002).

The study results show that pre-service teachers have high levels of academic self-efficacy regarding the accomplishment of an academic task. This may make us think that pre-service teachers with high levels of academic self-efficacy will learn better and have more qualified educational achievements and applications. The researchers state too that a student would be unable to learn sufficiently and try to pass the exams in case that she/he considered her/his effort insufficient (Zimmerhofer et al., 2006).

In the study, it was determined that only the academic self-efficacy made a significant contribution among variables predicting the teacher self-efficacy. The academic self-efficacy was observed to be the variable predicting the teacher self-efficacy at the rate of 26% (See Table 3). This may make us think about the necessity for examining how the educational experiences and knowledge of pre-service teachers could affect their profession better. However, the grade and academic achievement of pre-service teachers do not significantly predict the teacher self-efficacy, which may make us think that pre-service teachers could act according to a stronger teacher self-efficacy in order to accomplish an academic task. This may make us think that grade level and high academic achievement was not related to their teacher self-efficacy for the pre-service teachers. In their study that was performed with undergraduate students, Vrugt, Langereis and Hoogstraten (1997) determined that the academic self-efficacy significantly affected the exam performance. Chemers et al. (2001), on the other hand, suggested that the academic self-efficacy was among variables predicting the personal qualities such as the class performance, personal coherence, stress and health.

Considering the study results, no significant correlation was observed between the grades and academic achievements of pre-service teachers and their teacher self-efficacy. According to the results of the multiple regression analysis, it was determined that the class and accomplishment remained incapable in explaining the teacher self-efficacy and were unable to predict it, which may make us think about the necessity for examining how the educational experiences and knowledge of pre-service teachers could affect their profession better.

CONCLUSION

The study results show that pre-service teachers have high levels of teacher self-efficacy regarding their capacity of arranging the behaviors that are required to achieve certain educational goals and academic self-efficacy regarding their capacity of accomplishing an academic task. This condition is considered positive as it makes us think that they will have highly qualified and productive activities concerning their profession in the future, as well. Additionally, since the results point out the academic self-efficacy as the variable predicting the teacher self-efficacy, it makes us think about the necessity for supporting and developing the pre-service teachers to accomplish an academic task during their education. This condition reveals the importance of especially the teacher training programs and the duty of academic lecturers working there. Having information about the factors affecting the teachers' self-efficacy is important in terms of reinforcing the sufficiency perceptions of teachers.

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