PRE-SERVICE ELEMENTARY SCHOOL TEACHERS' MATHEMATICS ANXIETY AND MATHEMATICS SELF-EFFICACY AND THEIR RELATIONSHIP TO MATHEMATICAL TEACHING PERFORMANCE [1]

Osman ÇİL
Yrd.Doç. Dr., Ahi Evran Üniversitesi, ocil@ahievran.edu.tr

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ABSTRACT

Mathematics anxiety is a common phenomenon in a very competitive age that makes demands on individuals to exhibit their mathematical competence. Preparing pre-service teachers to effectively teach mathematics is repeatedly suggested as one way to decrease or prevent the negative effects of mathematics anxiety on elementary school students, since studies frequently portray elementary school teaching majors as having higher mathematics anxiety than other teaching majors. The aim of this quantitative study was to investigate the differences between pre-service elementary teachers' mathematics anxiety and mathematics teaching self-efficacy, based on their performance in a mathematics teaching method course. The data analysis revealed that pre-service teachers with high mathematics anxiety achieved lower scores and developed less self-efficacy than pre-service elementary teachers with low mathematics anxiety. There was also a statistically significant negative relationship between pre-service teachers' mathematics anxiety and their mathematics teaching self-efficacy.

Keywords: Pre-service teacher, elementary school teacher, mathematics anxiety, mathematics teaching self-efficacy.

SINIF ÖĞRETMENİ ADAYLARININ MATEMATİK KAYGISI VE MATEMATİK ÖĞRETİMİ ÖZ-YETERLİLİK ALGILARININ MATEMATİK ÖĞRETİMİ DERSİNDEKİ PERFORMANSLARI İLE İLİŞKİSİ

ÖZ

Bireylerin matematiksel işlem becerilerini günlük yaşamda sıklıkla kullanmak zorunda olduğu bu rekabete dayalı çağda, matematik kaygısı oldukça önemli bir olgu olarak dikkat çekmektedir. Sınıf öğretmeni adaylarının, diğer öğretmenlik branşlarına göre daha çok matematik kaygısı yaşadıkları sıklıkla alan yazında dile getirilmiş ve öğretmen adaylarına matematiği daha etkin bir şekilde öğretebilmek için destek verilmesinin, öğrencilerin matematik kaygısını azaltmak veya önlemek için önemli bir çözüm yolu olduğu belirtilmiştir. Bu nicel çalışma, sınıf öğretmeni adaylarının matematik kaygısı ve matematik öğretimi öz-yeterlilik algılarının matematik öğretimi dersindeki performansları ile olan ilişkisini incelemeyi amaçlamıştır. Ayrıca sınıf öğretmeni adaylarının

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matematiğe yönelik kaygı düzeyleri ile matematik öğretimi öz yeterlilik inançları arasında olumsuz yönde anlamlı bir ilişki gözlenmiştir.

Anahtar Kelimeler: Sınıf öğretmeni adayları, matematik kaygısı, matematik öğretimi öz-yeterliliği.

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GENİŞLETİLMİŞ ÖZET

Giriş

National Council of Teachers of Mathematics (NCTM) (2000) bireylere bu rekabetçi çağdaki günlük yaşama ayak uydurabilmeleri konusunda yardımcı olabilmenin temel şartının etkin öğretmenler ve matematiksel anlamda yetkin bireyler yetiştirmek olduğunu vurgulamıştır. Matematik dersine yönelik olan kaygının yol açtığı problemlerin ve bunların üstünden gelinebilmesi için etkin matematik eğitimi verebilecek öğretmenler yetiştirmenin öneminin altı sıklıkla çizilmiştir (Hoffman, 2010; Jain & Dowson, 2009). Yine alanyazında matematik dersine yönelik olan kaygının sadece öğrenciler üzerinde gözlenen bir problem olmadığı ve sınıf öğretmeni adaylarında da gözlendiği (Gresham, 2004) belirtilmiş ve sınıf öğretmeni adaylarının öğretmenlik öz-yeterlilikleri inançları üzerine sınırlı sayıda çalışma olduğunu belirtmiştir (Briley, 2012).

Metodoloji

Söz konusu çalışma, sınıf öğretmeni adaylarının matematik kaygılarının ve matematik öğretimi öz-yeterlilik algılarının matematik öğretimi dersindeki performansları ile olan ilişkisini incelemeyi amaçlamıştır. Söz konusu amaca ulaşılabilmek için aşağıdaki araştırma sorularına cevap aranmıştır:

1. Sınıf öğretmeni adaylarının matematik öğretimi dersi başarı düzeyleri ile matematik kaygıları arasında anlamlı bir farklılık var mıdır?

2. Sınıf öğretmeni adaylarının matematik öğretimi dersindeki başarı düzeyleri ile matematik öğretimi dersine yönelik öz-yeterlilik inançları arasında anlamlı bir farklılık var mıdır?

3.Sınıf öğretmeni adaylarının matematik dersine yönelik olan kaygıları, matematik öğretimine yönelik olan öz-yeterlilik inançları ve matematik öğretim dersindeki başarı düzeyleri arasında anlamlı bir ilişki var mıdır?

Söz konusu çalışma Türkiye'deki bir eğitim fakültesinde eğitim görmekte olan gönüllü 105 (89 kadın, 16 erkek) sınıf öğretmeni adayı üzerinde gerçekleştirilmiştir. Çalışmada amaçlı örneklem metotlarından ölçüt örneklem yöntemi kullanılmış ve katılımcıların en azından bir matematik öğretimi dersini tamamlamış olduklarından emin olunmuştur. Veri toplamak amacıyla *Matematik Kaygı Ölçeği* (MKÖ*) ve Matematik Öğretimi Yeterlilik İnanç Ölçeği* (MÖYIÖ*)* katılımcılara uygulanmış ve matematik öğretimi dersi başarı puanları hakkında bilgi toplanmıştır.

TARTIŞMA ve SONUÇ

Söz konusu çalışmanın bulguları alanyazındaki benzer çalışmalar ile örtüşmekte olup sınıf öğretmeni adaylarının matematik dersine yönelik kaygıları ile matematik öğretimine yönelik olan öz-yeterlilik inançları arasında olumsuz yönde bir istatiksel ilişki olduğunu ortaya çıkarmıştır (Bursal & Paznokas, 2006). Yine alanyazındaki bulgulara paralel olarak sınıf öğretmeni adaylarının matematik dersine yönelik kaygı düzeyleri ile matematik

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öğretimi dersi başarı düzeyleri arasında olumsuz yönde istatiksel olarak anlamlı bir ilişki bulunmuştur (Bates, Latham, & Kim, 2011). Öğretmenlerin matematik dersine yönelik olan kaygı düzeylerinin; matematik öğretimi becerileri (Gresham, 2008) ve matematik öğretirken kullanacakları yöntemleri seçimleri (Hart, 2002) üzerindeki etkileri göz önünde bulundurulduğunda öğretmen yetiştiren kurumların matematiğe yönelik kaygıyı azaltmak için çaba göstermesinin önemi ortaya çıkmaktadır.

Matematik dersine yönelik kaygı taşıyan sınıf öğretmeni adaylarının kaygı taşımayan öğretmen adaylarına göre matematik dersi ile ilgili konularda kendilerini daha rahatsız hissettikleri ve matematiğe yönelik olumsuz bir tutum geliştirdikleri açıkça ortadadır. Her ne kadar alan yazındaki pek çok çalışma öğretmen adaylarının matematik ile ilgili aldıkları ders sayısının nicel olarak artırıldığında matematiğe yönelik kaygılarının ve öz-yeterlilik inançlarının düştüğünü belirtse de (Rethlefsen & Park, 2011; Swars, Daane, & Giesen, 2006), Hembree' ninde (1990) vurguladığı gibi yalnızca matematik derslerinin sayısının nicel olarak artırılması matematik kaygısını düşürmeye yönelik etkili bir çözüm teşkil etmeyebilir. Söz konusu derslerin içeriğinin öğretmen adaylarının matematiğe yönelik kaygıları göz önünde bulundurularak etkin bir şekilde düzenlenmesi pek çok sınıf öğretmeni adayının matematiğe yönelik olan kaygılarının azaltılmasında yardımcı olacaktır.

Matematik öğretimi dersi başarı düzeyi düşük olan sınıf öğretmeni adaylarının matematik dersine yönelik olumsuz tutum geliştirdiği gözlenirken, matematik öğretimi dersi başarı düzeyi yüksek olan sınıf öğretmeni adaylarının matematiğe yönelik olumlu bir tutum geliştirmediği gözlenmektedir. Özellikle öğretmen adaylarının matematiğe yönelik tutumlarını öğrencilerine aktarabildikleri göz önünde bulundurulduğunda (Wood, 1988) matematiğe yönelik dersler planlanırken sadece matematik kaygısı yaşayan öğretmen adayları göz önünde bulundurulmamalı, matematik dersinde başarılı öğretmen adaylarının matematiğe yönelik olumlu tutum geliştirebileceği etkinlikler planlanmalıdır.

Matematik öğretimi dersi başarı düzeyleri düşük olan sınıf öğretmeni adaylarının matematik öğretimi öz-yeterlilik inançlarının daha düşük olduğu gözlense de, sınıf öğretmeni adaylarının matematik öğretimi başarı düzeyleri ile öğretmenin etkili öğretimde rolü ve öğretmen performansı arasında anlamlı bir fark yoktur. Sınıf öğretmeni adaylarının matematik öğretimi performanslarına, becerilerine ve rollerine yönelik inançlarının profesyonel kişilik gelişiminden etkilendiğini varsayılırsa, matematiğe yönelik kaygı göz önünde bulundurularak sınıf öğretmenliği ders programının bütüncül bir şekilde düzenlenmesi sınıf öğretmeni adaylarının matematik öğretimi öz- yeterlilik inançlarının gelişmesine yardımcı olacaktır.

INTRODUCTION

The National Council of Teachers of Mathematics (NCTM) (2000) highlights the importance of educating effective teachers to prepare individuals for the challenges of daily life and emphasizes the importance of mathematics competence, since it affords individuals opportunities to succeed in this competitive age. The need to prepare teachers to effectively teach mathematics is repeatedly highlighted in the literature, since studies over last few decades have shown mathematics anxiety to be a significant problem for many students

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(Hoffman, 2010; Jain & Dowson, 2009). However, mathematics anxiety is not only a significant problem for students, but also highly evident in pre-service teachers (Gresham, 2004). As researchers like Gresham (2007) suggest, pre-service elementary school teachers have higher mathematics anxiety than other teaching majors. This issue is especially important since pre-service teachers' anxiety towards mathematics could manifest when they start working as teachers and affect their teaching practices (Trice & Ogden, 1987) and content knowledge (Brand & Wilkins, 2007) which, in turn, can lead teachers to transfer their anxiety towards mathematics to their students (Wood, 1988). Exposing students, especially young students, to teachers that have such negative attitudes and behaviors towards mathematics might affect students' mathematics competence and make them less able to answer to the challenges of this demanding age.

Although, as Gresham (2008) suggests, it is important to help pre-service elementary teachers develop positive attitudes towards mathematics-related topics and acquire effective mathematic teaching skills, there are a limited number of studies in the literature that explore the connections between pre-service teachers' mathematics anxiety and their mathematics teaching efficacy. Briley (2012) echoes this notion, emphasizing the lack of research on pre-service elementary teachers' teaching efficacy. This quantitative study was designed to contribute to the literature by exploring the connections between pre-service teachers' mathematics anxiety and their mathematics teaching self-efficacy beliefs, and by exploring their connections to a mathematics teaching methods course.

LITERATURE REVIEW

A simple word like *mathematics* can induce panic in many individuals' hearts and minds, and for decades researchers have thoroughly explored this common fear. A large number of studies have addressed the connections between mathematics anxiety and self-efficacy beliefs (Hoffman, 2010); between mathematics anxiety and mathematical performance (Ashcraft & Moore, 2009); and between pre-service teachers' mathematics self-efficacy beliefs and mathematical performance (Bursal, 2009; Bates, Latham, & Kim, 2011). There is also a body of literature that focuses on mathematics anxiety in pre-service elementary school teachers (Harper & Daane, 1998; Gresham, 2007).

Mathematics anxiety can be defined as individuals' fear or discomfort towards mathematical subjects, such as mathematical problems or numerical operations, which effects their academic performance and leads them to avoid mathematics in daily life situations (Vinson, 2001; Richardson & Suinn, 1972). For instance, individuals who have mathematics anxiety might fear taking a mathematics test, have trouble understanding a mathematical concept, or have problem making various numerical manipulations (Ma & Xu, 2004). This fear or discomfort towards mathematics could be caused by former negative academic experiences and a lack of understanding of mathematical concepts (Bates, Latham, & Kim, 2011). Mathematic anxiety might not only cause individuals to evade any mathematics-related subject and possibly develop mathematics phobia

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(Gresham, 2008), but it might also arouse negative feelings such as tension, stress, and concern when they are asked to perform mathematical tasks (Hart, 2002).

Various studies have identified a strong negative correlation between mathematics anxiety and high mathematical performance (Cates & Rhymer, 2003) and have found that highly math-anxious individuals tend to perform more poorly on mathematics-related tasks than low math-anxious individuals. However, researchers like Ashcraft and Faust (1994) highlight the fact that although mathematics anxiety might have a limited effect on individuals' performance, it can harm their ability to learn mathematics. For example, mathematics anxiety can affect individuals' mathematics learning skills, such as fluency (Cates & Rhymer, 2003) or mathematical decision-making processes (Ashcraft & Faust, 1994; Faust, Ashcraft, & Fleck, 1996). It can also influence individuals' perspectives and trigger avoidance towards mathematics courses and mathematics-related subjects (Ashcraft, 2002). It can even affect teachers and their practices; for instance, Hart (2002) observed how a pre-service teacher with high levels of math anxiety tended to use traditional methods and directions, but when her beliefs about mathematics started to change and her anxiety started to diminish, she chose to use more complex methods when teaching mathematics. Vinson echoed (2001) this notion, suggesting a positive association between an instructor's experiences and efficacy in teaching mathematics and his or her students' levels of mathematics anxiety. In other words, instructors' mathematics anxiety can affect their practices, and ineffective practices and poorly constructed and performed mathematics courses, in turn, affect students' perspectives on mathematics and trigger anxiety towards mathematics (Gresham, 2008; Trice & Ogden, 1986).

As mentioned above, there is large amount of research that connects high mathematics anxiety with low mathematical performance (Ashcraft & Kirk, 2001); similarly, researchers discern associations among high mathematics anxiety, low mathematics self-efficacy (Hackett & Betz, 1989; Kvedere, 2014), and low mathematics teaching efficacy (Gresham, 2008). For instance, Gresham (2008) suggested that teachers who have higher mathematics anxiety have less confidence in their teaching skills, and teachers who have low mathematics anxiety tend to utilize alternative methods or educational objects, such as problem-solving situations and manipulatives, more frequently.

Another important cognitive concept that influences individuals' performance is self-efficacy. Bandura (1997) defines self-efficacy as "beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments" (page, 3). It is clear that the concept of self-efficacy may not only affect individuals' mathematical performance (Pajares & Graham, 1999); it could also be a factor that regulates mathematical anxiety (Shores & Shannon, 2007). In other words, individuals' self-efficacy beliefs regarding mathematics directly affect some of their attributes, such as values, motivation, and perspectives, which, in turn, indirectly influences the coping mechanisms, attitudes towards learning, and decision-making processes that might lead to success or failure. Bandura (1994) identifies four different types of processes to explain how self-efficacy beliefs affect individuals' performance and functioning: *cognitive, motivational, affective,* and *selection*.

Cognitive processing is mostly concerned with the attributes of individuals that help them set goals, understand rules of daily affairs, predict future events, and develop the analytic thinking ability to formulate thoughts. For instance, having high self-efficacy on mathematics-related topics might encourage individuals to build connections between mathematics-related subjects and daily life events—for example, predicting the amount of paint required to paint a room—which in turn increases individuals' understanding and performance of mathematical concepts. *Motivational processes* are another important attribute that might influence individuals' performance, since individuals' motivation levels affect the goals individuals set, their efforts, and their tenacity in enduring hardships. For instance, people who have high motivational attitudes towards mathematics might set higher goals and put more energy into achieving these goals and thereby become more successful at mathematics-related tasks. *Affective processes* are mostly related to individuals' beliefs about their ability to cope with problematic situations, which might be useful for adjusting their stress and anxiety. For example, individuals who can better manage their levels of mathematics anxiety might perform better and achieve higher grades on mathematics exams. *Selection processes* are mostly associated with individuals' ability to handle environmental and/or social setbacks by materializing a sense of collective self-efficacy. For instance, in order to decrease their anxiety levels, highly mathematics anxious individuals might choose to create a support group to alleviate their concerns about mathematics-related issues.

Of course, individuals' mathematics anxiety and self-efficacy levels towards mathematics not only might affect their performance in this area, but could also affect these individuals' teaching self-efficacy. Teaching self-efficacy can simply be defined as teachers' belief in their ability to educate their students successfully; teaching mathematics self-efficacy can be defined as teachers' beliefs in their ability to teach mathematics effectively (Bursal, 2009). Mathematics self-efficacy affects individuals' perspectives and performance in regard to mathematics-related activities. For instance, pre-service teachers who have high self-efficacy in regard to mathematics-related subjects tend to enroll in more complex mathematics courses (Hall & Ponton, 2005) and display better mathematical performance (Skaalvik, Federici, & Klassen, 2015). When individuals continually exhibit poor mathematical performance, their mathematical anxiety might deepen and they might start to show signs of mathematical avoidance. The presence of these negative conditions in teacher training programs might raise further problems, since there is a significant chance that pre-service teachers might communicate their mathematics-related attitudes to their students (Trice & Ogden, 1986).

METHODOLOGY

As mentioned in the previous section, over the last few decades a significant amount of research has repeatedly cautioned teacher-training programs about the high incidence of mathematical anxiety among pre-service teachers and its negative effects on their performance. Although there is a significant amount of research that focuses on mathematics anxiety and self-efficacy concerning mathematics-related issues, only a few studies focus on pre-service teachers' mathematics teaching self-efficacy (Briley, 2012). With these perspectives in mind, this quantitative study was designed to explore the connections among pre-service

elementary teachers' mathematics anxiety, their beliefs in their mathematics teaching self-efficacy, and their performances in a mathematics teaching methods course, focusing on the following research questions:

1. Is there a difference in pre-service elementary teachers' levels of mathematics anxiety on their mathematics teaching method course performances?
2. Is there a difference in pre-service elementary teachers' levels of mathematics teaching self-efficacy on their mathematics teaching method course performances?
3. What are the correlations among pre-service elementary teachers' levels of mathematics anxiety, mathematics teaching self-efficacy, and mathematics teaching method course performances?

Sampling process

This study was conducted with 105 pre-service elementary teachers (89 female, 16 male) in a teacher training institution in Turkey. The participants were chosen with the criterion sampling method, which dictated that every participant in this study must have completed at least a college methods course designed to educate pre-service teachers on how to teach mathematics effectively to elementary school students.

Data gathering and analysis

To explore the research questions, a well-designed survey, which included the Matematik Kaygı Ölçeği (MKÖ) scale, the Matematik Öğretimi Yeterlilik Inanç Ölçeği (MÖYIÖ) scale, and a question that requested information on the participants' mathematics teaching method course graduation scores, was employed to acquire data. Eleven of these data-gathering sheets were eliminated due to the respondents' failure to complete all of the items on the survey, especially items regarding the participants' mathematics teaching method course graduation scores.

The researcher chose to use the *Matematik Kaygı Ölçeği* (MKÖ*),* an adaptation of the Mathematics Anxiety Scale translated and modified into Turkish (MAS_R*),* to explore the pre-service elementary teachers' anxiety towards mathematics, since it has a high internal consistency (α= .91). The MKÖ uses a five-point Likert type scale that registers the respondent's agreement with each statement by indicating (1) "strongly disagree," (2) "disagree," (3) "undecided," (4) "agree," and (5) "strongly agree." The MKÖ has two subscales that measure attitudes toward mathematics: the Positive Attitude Subscale (items 1, 3, 5, 10, 12, and 13) and the Negative Attitude Subscale (items 2, 4, 6, 7, 8, 9, 11, and 14) (Akçakın, Cebesoy & İnel, 2015).

The researcher also utilized the *Matematik Öğretimi Yeterlilik İnanç Ölçeği* (MÖYIÖ*),* an adaptation of the Mathematics Teaching Efficacy Beliefs Instrument (MTEBI) into Turkish*,* to investigate pre-service elementary teachers' perception towards teaching mathematics, as the scale has a relatively high internal consistency (α= .712). This Likert-type adapted scale is designed to explore individuals' perceptions of teaching mathematics, utilizing five points: (1) "strongly disagree," (2) "disagree," (3) "undecided," (4) "agree," and (5) "strongly agree." The MÖYIÖ consists of three subscales: the Mathematics Teaching Self-Efficacy Subscale (items 3, 6, 8,

15, 19, and 21); the Teacher's Role in Effective Mathematics Teaching Subscale (items 4, 7, 9, 10, 12, 13, and 20): and the Mathematics Teaching Performance Subscale (items 1, 2, 11, and 14).

Since the data were normally distributed, an ANOVA test was used to explore the differences between the pre-service elementary teachers' levels of mathematical anxiety and their mathematics teaching method course scores. Similarly, an ANOVA test was used to investigate the differences between the pre-service elementary teachers' levels of mathematics teaching self-efficacy and their mathematics teaching method course scores. Also, the researcher used the Tukey test to interpret the data. Finally, the researcher utilized Pearson's *r* test to explore the correlations among the pre-service elementary teachers' levels of mathematics anxiety, mathematics teaching self-efficacy, and mathematics teaching method course scores.

FINDINGS

As can be seen in Table 1, there is a significant difference in the pre-service elementary teachers' levels of mathematics anxiety in relation to their mathematics teaching method course scores, F(2,92)=6.634, p<.05. The analysis of Tukey's tests reveals that the pre-service teachers who had low achievement had higher mathematics anxiety ($\overline{X}$ =2.96) than the teachers who had moderate ($\overline{X}$ =2.21) and high ($\overline{X}$ = 2.16) achievement scores.

As can be seen in Table 2, when the results are examined for the pre-service teachers' mathematics anxiety, as measured by the negative attitude subscale, they reveal a statistically significant difference between low-moderate and low-high-achieving teachers, F (2,92)=7.850, p< .05. The pre-service elementary teachers who scored low in the mathematics teaching method course had higher negative attitudes ($\overline{X}$ =3.32) towards mathematics than the pre-service elementary teachers who had moderate ($\overline{X}$ =2.33) and high ($\overline{X}$ = 2.30) achievement scores. The results did not reveal any meaningful differences in positive attitudes towards mathematics among the low-, moderate-, and high-achieving groups.

Table 1. Results of one-way ANOVA; Pre-Service Elementary Teachers Mathematics' Anxiety Results by Mathematics Teaching Method Course Performances

	Sums of Squires	df	Mean Squire	F	p	Tukey
Between Groups	6.720	2	3.360	6.634	.002	Low-Moderate; Low-High
Within Groups	46.602	92	.507			
Total	53.323	94				

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As the results shown in Table 3 indicate, there are no meaningful differences among the means of the pre-service elementary teachers' mathematics teaching self-efficacy scores within the low-, moderate- and high-achieving groups, F(2,92)=1.843, p> .05.

Table 2. Results of one way ANOVA; Pre-Service Elementary Teachers Positive And Negative Attitude Subscale Scores Towards Mathematics' Anxiety Results by Mathematics Teaching Method Course Performances

	Sums of Squires	df	Mean Squires	F	p	Tukey
Negative Attitude Subscale						
Between Groups	11,244	2	5,622	7,850	,001	Low-Moderate; Low-High
Within Groups	65,883	92	,721			
Total	77,127	94				
Positive Attitude Subscale						
Between Groups	2,527	2	1,264	2,484	,089	
Within Groups	46,799	92	,509			
Total	49,326	94				

Table 3. Results of one way ANOVA; Pre-Service Elementary Teachers' Mathematics Teaching Self-Efficacy Results by Mathematics Teaching Method Course Performances

	Sums of Squires	df	Mean Squire	F	p	Tukey
Between Groups	,707	2	,353	1,843	,164	
Within Groups	17,649	92	,192			
Total	18,355	94				

However, when we look more closely and explore the subscales, we arrive at a clearer picture. As it can be seen in Table 4, while a statistically significant difference is revealed by the pre-service elementary teachers' mathematics teaching self-efficacy subscale scores, F(2,92)=4.606, p<.05, there are no meaningful differences among the pre-service elementary teachers' role in effective mathematics teaching subscale scores, F(2,92)= .126, p>.05, and mathematics teaching performance subscale scores, F(2,92)= .545, p>.05, when they are grouped as low-, moderate-, and high-achieving teachers. According to the Tukey tests, the mathematics teaching self-efficacy subscale mean scores of the high-achieving teachers ($\overline{X}$ =4.05) differ significantly from those of the low-achieving teachers ($\overline{X}$ =3.45).

Table 4. Results of one way ANOVA; Pre-Service Elementary Teachers' Personal Competence, Teachers' Role, and Teaching Performance Sub-Scale Scores Towards Mathematics' Teaching Efficacy Results by Mathematics Teaching Method Course Performances

	Sums of Squires	df	Mean Squires	F	p	Tukey
Personal Competence Subscale						
Between Groups	3,557	2	1.778	4.606	.012	High-Low
Within Groups	35,523	92	.386			
Total	39,080	94				
Teacher's Role in Effective Teaching Subscale						
Between Groups	.073	2	.036	.126	.882	
Within Groups	26.588	92	.289			
Total	26.660	94				
Teaching Performance Subscale						
Between Groups	.291	2	.146	.545	.582	
Within Groups	24.584	92	.267			
Total	24.875	94				

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The results of the Pearson correlation tests reveal significant negative relationships between teachers' levels of mathematics anxiety and their mathematics teaching method course scores (r=-.256, p<.05) and teachers' levels of mathematics anxiety and their mathematics teaching self-efficacy (r=-.327, p<.01). That is, the results indicate that teachers with high math anxiety had low levels of mathematics teaching self-efficacy and low teaching method course scores, while the teachers with low mathematics anxiety had high levels of mathematics teaching self-efficacy and high scores in the mathematics teaching method course. There was no statistically significant correlation between mathematics teaching self-efficacy and mathematics teaching method course scores (r= .195, p>.05).

Table 5. Results of The Pearson Product Moment Correlations; Teachers' Levels of Mathematics Anxiety, Mathematics Teaching Self-Efficacy, and Mathematics Teaching Method Course Performances

		Mathematics teaching method course scores	*Teachers' levels of mathematics anxiety*
Teachers' levels of mathematics anxiety	Pearson Correlation	-. 256	
	Sig. (2-tailed)	.012	
	N	94	
Mathematics teaching self-efficacy	Pearson Correlation	.195	-.327
	Sig. (2-tailed)	.060	.001
	N	94	94

DISCUSSION

The findings of this study align with the findings in the literature on mathematics anxiety, since the results show a negative relationship between pre-service elementary school teachers' levels of mathematics anxiety and their mathematics teaching self-efficacy (Bursal & Paznokas, 2006). The study also revealed a negative relationship between pre-service elementary school teachers' levels of mathematics anxiety and their mathematics teaching method course scores (Bates, Latham, & Kim, 2011). When we consider the well-established effects of mathematics anxiety on teachers, such as a lack of confidence in mathematics teaching ability (Gresham, 2008), a tendency to utilize simpler and safer teaching methodologies (Hart, 2002), and the threat of transforming teachers' mathematics anxiety to their students (Vinson, 2001; Trice & Ogden, 1986), it becomes imperative for teacher training institutions to create ways to lessen the anxiety of pre-service teachers towards mathematics.

One step toward decreasing pre-service teachers' mathematics anxiety could be to get a better understanding of pre-service teachers' perspectives on mathematics-related subjects. In this study, the pre-service teachers who had lower mathematics teaching method course scores developed higher levels of negativity towards mathematics than pre-service teachers who had moderate and high course scores. It is clear that pre-service teachers with high mathematics anxiety do not feel comfortable dealing with mathematics-related content, and they develop more negative emotions towards mathematics than their less mathematics anxious peers. Although many studies highlight how taking more mathematics courses can decrease pre-service teachers' mathematics anxiety and increase their mathematics teaching efficacy (Rethlefsen & Park, 2011; Swars, Daane, & Giesen, 2006), it should not be forgotten that the content of these methods courses heavily affects pre-

service teachers' perspectives on mathematics-related activities. As Hembree (1990) suggests, increasing the number of mathematics method courses that pre-service teachers take in teacher training programs might not be an effective solution. Nevertheless, it is clear that we should tailor mathematics methods courses to mathematics-anxious pre-service teachers, so that they can effortlessly acquire the required theoretical knowledge and successfully apply their knowledge and skills in real-life situations, and so that they can feel more comfortable using mathematics in their daily lives and developing positive attitudes towards mathematics.

Surprisingly, the pre-service teachers who had higher mathematics course scores than their peers did not hold any more positive attitudes towards mathematics than their peers. In other words, while low-achieving pre-service elementary teachers developed more negative perspectives towards mathematics-related activities than their higher-achieving peers, the latter's perspectives were not more positive than those of the former. This finding suggests that teacher training programs should not only help pre-service elementary teachers develop their theoretical knowledge of mathematics, but also take steps to create opportunities for pre-service elementary teachers who are successful at teaching mathematics to develop a positive attitude towards mathematics. One of the ways to succeed at this could be to present doable mathematical challenges to pre-service teachers that have a greater aptitude for mathematics, since they have enough mathematical skills and self-efficacy beliefs to solve mathematical problems. For instance, solving real-life problems with mathematical modeling methodologies could help them to realize how mathematics is an integral part of their life, whether they are aware of it or not, and how they and their students can use mathematics as a problem-solving tool in their daily lives.

Like many other studies, this study revealed a statistically significant negative relationship between pre-service elementary teachers' levels of mathematics anxiety and their mathematics teaching self-efficacy beliefs (Bursal & Paznokas, 2006; Gresham, 2008; Swars, Daane, & Giesen, 2006). Pre-service elementary teachers who had lower mathematics anxiety developed higher levels of confidence in their mathematics teaching skills. As Chen (2002) suggests, helping individuals to appropriately adjust their levels of self-efficacy beliefs could positively affect their performance. The data analysis revealed a statistically significant relationship between the pre-service teachers' mathematics self-efficacy sub-scale and the mathematics method course achievement scores, while there were no statistically meaningful relationships between the teacher's role in effective mathematics teaching sub-scale and the mathematics teaching performance sub-scale. In other words, the pre-service elementary teachers who scored lower in the mathematics teaching method course had less belief in their competence to teach mathematics than their higher achieving peers. However, there were no statistically significant differences between the achievement levels of the pre-service elementary teachers in the mathematics teaching method courses and their perspectives on their role and performance as a teacher. It is clear that the pre-service elementary teachers in this study chose not to relate their role and prospective performance as a teacher with their mathematics course scores. The pre-service teachers' perspectives on their mathematics teaching self-efficacy could help teacher training programs develop a curriculum that perceives

mathematics anxiety and mathematics teaching self-efficacy holistically, since the pre-service elementary teachers' perspectives on their abilities, roles, and performances are significantly affected by their professional identity development. Thus, it becomes imperative for teacher training programs to develop a curriculum that helps pre-service elementary teachers, through four years of college education, to become more comfortable with mathematics-related content and mathematics-related activities.

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