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Gender Differences in Geometry and Mathematics Achievement and Self-efficacy Beliefs in Geometry

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Abstract

Problem Statement: Individual differences in education have great importance. Such differences become particularly crucial in disciplines such as mathematics and geometry. One of the most frequently investigated individual differences is gender-related. Gender differences in mathematics may be different depending upon the particular area of mathematics. Therefore, gender differences in geometry performance and efficacy deserve attention.

Purpose of Study: The present study is aimed to investigate gender differences in mathematics course achievement, geometry course achievement, and geometry self-efficacy.

Methods: A total of 199 high school sophomores voluntarily participated in the study. A mathematics and geometry end-of-the-year GPA was obtained from the official student records. Students responded to a set of brief demographic questions that asked their gender in addition to the Self-efficacy Scale toward Geometry (SESTG). Data were screened for the assumptions of parametric statistics. In order to test mathematics and geometry end-of-the-year achievement differences simultaneously between men and women, a between-subjects MANOVA was used. A second MANOVA was used to test three dependent variables of self-

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efficacy beliefs simultaneously in a non-orthogonal design. The independent variable was gender (male and female).

Findings and Results: Results showed that there was a significant multivariate effect of gender on the combined dependent variables. There was a large association both between the dependent variables and gender. The results of univariate *F* analyses indicated that there were significant gender differences on both mathematics achievement and geometry achievement. Women achieved significantly higher than men. A second one-way, between-subjects MANOVA was performed on the three dependent variables that were the subscales of the SESTG. The independent variable was gender. Results showed that there was not any significant multivariate effect of gender on the combined dependent variables.

Conclusions and Recommendations: Variables that may have an effect on mathematics or geometry achievement are multi-faceted. The present study focused on one of such variables, namely gender. We investigated the relationship between self-efficacy beliefs in geometry and geometry achievement and found that the two variables were significantly related. The present study also shows a significant relationship between the mathematics and geometry achievement level. Results show that there are not any significant multivariate gender differences on the sub-scales of the geometry self-efficacy beliefs.

Keywords: Gender differences, mathematics course achievement level, geometry course achievement level, geometry self-efficacy beliefs

Individual differences in education have great importance. Such differences become particularly crucial in disciplines such as mathematics and geometry. One of the most frequently investigated individual differences is gender-related (Benbow & Stanley, 1980, 1982; Ethington & Wolfle, 1986; Fennema & Sherman, 1977; Hilton & Berglund, 1974; Marshall & Smith, 1987; Meece, Parsons, Kaczala, Goff, & Futterman, 1982). By means of social learning, individuals learn about gender-related stereotypes, roles, behaviors, and attitudes (Uzzell & Natalie, 2006). According to the dominant cultural belief patterns, males are more competent, independent, decisive, and rational; on the contrary, females are less competent, competitive, ambitious, independent, and active (Broverman, Vogel, Broverman, Clarkson, & Rosenkrantz, 1972). When interviewed on gender-related beliefs and roles, students attributed the following qualities to males: athletically and mechanically gifted, good at grasping economics, good observers, intellectually excellent, good at grasping science, and having theoretical understanding, common sense, expertise, and professional skills (Bruess & Greenberg, 2004). On the other hand, strong social skills, an understanding of interpersonal relationships, appreciation for art, domestic skills, satire appreciation, and physical appearance were attributed to women (Bruess & Greenberg, 2004).

Gender studies in mathematics have usually shown that even though boys and girls are indifferent regarding mathematics learning throughout elementary school years, girls start falling behind boys in mathematics achievement with the beginning of middle school, and by the time they reach high school, the gender gap widens dramatically (Fennema, 1974, 1980, 1985; Hanna, 1986; Hopkins, Lisi, & Lisi, 1997; Hyde, Fennema, & Lamon, 1990; Kimball, 1989; Leder, 1985; Marshall, 1984; Peterson & Fennema, 1985). The majority of the studies confirm that boys achieve significantly higher than girls in high school mathematics (Hedges & Nowell, 1995; Peterson & Fennema, 1985; Randhawa, 1994), whereas fewer studies show that the difference is not significant (Barker, 1997; Bronholt, Goodnow, & Conney, 1994; Collins, 1985; Hyde et al., 1990; Knodel, 1997; Lloyd, Walsh, & Yailagh, 2005; Savaş & Duru, 2005). Yet, some other studies show that the nature of mathematics may be important when looking into gender differences in mathematics (Pattison & Grieve, 1984; Stage, Kreinberg, Eccles, & Becker, 1985). For example, Stage et al. (1985) found that boys scored slightly higher than girls on mathematical reasoning; however, girls scored higher on computational skills. The same study found no difference between the two groups on algebra or mathematical knowledge tests. Pattison and Grieve (1984) showed that tenth- and twelfth-grade girls scored significantly higher than boys on logic and geometric reasoning, but boys scored higher on scale and three-dimensional-solid geometry tests. In Turkey, the Third International Mathematics and Science Study (TIMSS) reports that eighth-grade boys and girls did not differ statistically on mathematics performance tests (Mullis, Martin, Fierros, Goldberg, & Stemler, 2000). In another study, eighth grade Turkish girls scored significantly higher than boys on probability tests (Bulut, 1994).

The theoretical models that focus on gender and mathematics performance usually start with the assumption that males outperform females in mathematics. Consequently, such models attempt to explain the reason(s) of such differences. For example, Eccles (1987) and Meece et al. (1982) hypothesize this expectation by the value model in order to explain differences in mathematics course-selection choices in high school. Fennema and Peterson (1985) propose an autonomous learning behavior model that suggested that failure to participate in independent learning in mathematics contributes to the development of gender differences in mathematics performance. On the other hand, others have developed theories based on biological fundamentals (Geary, 1996). Hyde et al. (1990) criticize the existing models as being premature and suggest that gender differences in mathematics performance be re-evaluated. In addition to controversies in mathematics performance comparisons, Jones and Smart (1995) argue that even girls who get higher grades in high school mathematics maintain less-favorable attitudes towards mathematics, and boys are shown to perceive mathematics as more useful to them in the future (Thorndike-Christ, 1991).

Hopkins et al. (1997) support that gender differences in mathematics may be different depending on the particular area of mathematics. Therefore, gender differences in geometry performance and efficacy deserve attention. Geometry has an important place in everyday life, in mathematics, and in the other branches of science (Bulut & Köroğlu, 2000). Bishop (1983) defines geometry as the mathematics

of space. From a theoretical perspective, the educators of mathematics consider spatial ability as the element of geometry (Gorgorio, 1998; Ubuz, Üstün, & Erbaş, 2009). Olkun (2003) explains that spatial ability encompasses skills in using space and geometric structures. Battista (1990) indicates that spatial ability is one of the most important factors in geometry achievement and problem-solving skills in geometry. A review of literature shows a positive relationship between spatial ability and mathematics achievement (Battista, Wheatley, & Talsma, 1982; Carpenter, 1980; Connor, & Serbin, 1985; Hatfield, Edwards, & Bitter, 1989; Lean, & Clements, 1981; Tartre, 1990). In a recent study, Németh (2007) found that male students had higher spatial ability compared to female students. Dees (1982) also indicated that males start geometry classes with higher geometry background knowledge compared to females.

One of the reasons behind lower achievement in mathematics and geometry has been identified as negative attitudes towards these subjects (Cantürk-Günhan & Başer, 2007; Kesici & Erdogan, 2009). In addition, attitudes toward these subjects may affect students' efficacies. Bandura (1986) defines self-efficacy as "people's judgments of their capabilities to organize and execute courses of action required to attain designated types of performances" (p. 391). A student's self-efficacy includes his information about past performances, observations of others, persuasion by others, and physiological responses (Schunk, 1989, 1994).

Self-efficacy beliefs strongly influence which activities individuals choose, how much effort they spend to accomplish those activities and how much willingness they have in dealing with the difficulties they face (Bandura, 1977). In addition, self-efficacy beliefs are also influential in increasing individuals' motivation, and thus their performance, by framing the behaviors and cognitive abilities that are necessary for successfully completing a task (Bandura, 1977; Pajares & Miller, 1994). More specifically, the mathematics self-efficacy belief is defined as "a situational or problem-specific assessment of an individual's confidence in her or his ability to successfully perform or accomplish a particular [mathematical] task or problem" (Hackett & Betz, 1989, p. 262). A review of current literature consistently shows that there is a significant relationship between mathematics achievement and mathematics self-efficacy beliefs (Hackett & Betz, 1989; Spence & Usher, 2007; Stevens, Olivarez, & Hamman, 2006). Similarly, mathematics self-efficacy has been a stronger predictor of mathematics performance than mathematics anxiety or gender (Kranzler & Pajares, 1997).

Because self-efficacy beliefs are relevant to individuals' own capacities, it may be expected that those students who are successful in mathematics and geometry also have higher levels of self-efficacy beliefs regarding the subjects. Bandura (1997) theorized that subject-specific, task-specific, and problem-specific self-efficacy beliefs form independently within an academic domain. Subject-specific self-efficacy refers to the self-efficacy a person has in regards to a particular subject, such as algebra or geometry. Subject-specific self-efficacy is more general than either task-specific self-efficacy or problem-specific self-efficacy (Noblitt, 2006). Researchers have developed and used more specific self-efficacy measures such as the Statistics Self-efficacy Scale

(Finney & Schraw, 2003) and Algebra Self-efficacy Scale (Noblitt, 2006) in studying subject-specific self-efficacy and achievement relations.

Previous mathematics experiences are strongly influential in mathematics learning and achievement (Green, 1974). If there are meaningful differences between men and women on mathematical ability or achievement, it is possible to label such differences as "gender differences." The present study was conducted on a sample of men and women who had a similar mathematics background. These students were admitted to their current high schools after successfully passing a centralized exam, which is quite competitive and heavily focuses on mathematics. Therefore, it is expected that the background and knowledge variability among these students will be smaller. The study was conducted to investigate the extent to which this assumption was met.

In summary, there is plenty of research showing a strong relationship between achievement and self-efficacy in that those individuals who have higher self-efficacy levels tend to achieve higher. The present study aims to investigate gender differences in self- efficacy. More specifically, this study provides insight into the following questions:

1. Is there a significant relationship between self-efficacy beliefs in geometry and achievement in geometry?
2. Is there a significant relationship between mathematics achievement and geometry achievement?
3. Is there a significant difference between mathematics or geometry achievement levels in male and female students?
4. Is there a significant difference between self-efficacy beliefs of male and female students in geometry?

Method

Sample

A total of 199 high school sophomores from an Anatolian high school in Konya voluntarily participated in the study. Of the sample, 100 were men (50.3%) and 99 were women (49.7%). Students' end-of-the-year mathematics grade point averages (GPA) ranged from 20 to 98 (out of 100) with a mean of 68.06 (SD = 18.90). The geometry end-of-the-year GPA ranged from 27 to 99 (out of 100) with a mean of 74.19 (SD = 13.40).

Instrument

The mathematics and geometry end-of-the-year GPA was obtained from the official student records. Students responded to a set of brief demographic questions in addition to the Self-efficacy Scale Toward Geometry (SESTG; Cantürk-Günhan & Başer, 2007). The SESTG is a 25-item, five-point Likert instrument that purports to measure students' self beliefs regarding their efficacy in doing geometry. The scale's content validity was studied by agreement among three faculty members. Construct validity was studied from the scores of 285 secondary school students. Factor analysis revealed three factors. The first factor (positive self-efficacy beliefs) had an eigenvalue of 6.85 and accounted for 27.41% of the variability. This factor included 12

items whose loadings ranged from .49 to .72. The second factor (application of geometry knowledge) had an eignevalue of 2.45, accounted for 9.81% of the variability, and included six items whose factor loadings ranged from .50 to .72. The last factor (negative self-efficacy beliefs), which had an eignevalue of 1.30, accounted for 5.20% of the variability in the scores and included seven items whose loadings ranged from .51 to .68. All together, three factors accounted for 42.42% of the total variability. In the same group, items in these three factors show acceptable internal consistency coefficients: .87, .73, and .69, respectively. On a separate group of 385 secondary-school students, authors found similar internal consistency results for the three sub-scales (i.e., .88, .70, .70, respectively) and the total scale scores (.90).

Procedure

After the permission to use the SESTG was obtained, a research package including the demographic questions and the items of the SESTG was assembled. Students were contacted during their classes and informed about the study. Participants signed consent forms. All administrations were completed during class hours, which took approximately 30 minutes. Students were given extra course credit for participation in the study. The Statistical Package for Social Sciences 10.0 (SPSS Inc, 2000) was used to code and analyze the data.

Data were screened for the assumptions of parametric statistics. Normality, homogeneity of variances, and linearity assumptions for each cell were tested at multivariate levels. Two separate multivariate analyses of variance (MANOVA) procedures were performed. In order to test mathematics and geometry end-of-the-year achievement differences simultaneously between men and women, a between-subjects MANOVA was used. A second MANOVA was used to test three dependent variables (i.e., Positive Self-efficacy Beliefs, Application of Geometry Knowledge, and Negative Self-efficacy Beliefs) of self-efficacy beliefs simultaneously in a non-orthogonal design. The independent variable was gender (male and female). For both analyses, if a multivariate significance was found, the analysis proceeded with univaraite *F*-tests (Tabachnick & Fidell, 2007). In addition to multivariate test statistics values, *F*s and statistical significances, effects sizes (η^2) and power estimates were reported (Burba, Petrosko, & Boyle, 2001). As suggested by Cohen (1988), 0.01 is accepted as a small effect, 0.06 a moderate effect, and 0.14 a large effect. Significance was set at $p<.05$. Lastly, internal consistency reliability coefficients (alpha) for the scales used in the study are reported (Table 1).

Findings and Results

Means, standard deviations, Pearson product-moment correlation coefficients, and internal consistency coefficients for the variables studied were computed and reported in Table 1. As the table shows, there was a significant relationship between mathematics and geometry achievement as well as significant relations between self-efficacy beliefs and geometry achievement. In addition, all subscales of the SESTG were interrelated.

Table 1

Results Regarding the Relationship Between Subscales

	1.	**2.**	**3.**	**4.**	**5.**
1. Mathematics Course Achievement	-				
2. Geometry Course Achievement	.66**	-			
3. Positive Self-efficacy Beliefs	-.01	.25**	-		
4. Application of Geometry Knowledge	.02	.19**	.76**	-	
5. Negative Self-efficacy Beliefs	-.04	-.20**	.39**	-.17*	-
Mean	68.06	72.29	42.90	19.58	7.74
Mean/number of items	-	-	3.58	3.26	2.53
Standard Deviation	18.90	13.40	8.64	4.82	5.92
Internal Consistency	-	-	.87	.74	.82

* $p < .05$; ** $p < .01$

Before the multivariate analyses, the assumption of multivariate normality was evaluated. Any case with a Mahalanobis distance greater than $\chi^2_{(27)} = 55.48$ was regarded as a multivariate outlier ($p < .001$). There were five multivariate outliers in the data set, and they were eliminated, leaving the sample size with 194 students. The homogeneity of variance assumption was met for the achievement and self-efficacy comparisons [$F_{(3,\ 6727021)} = 3.56$, $p > .001$] as indicated by the non-significant Box's M values.

A one-way, between-subjects MANOVA was performed on the two dependent variables: mathematics course achievement and geometry course achievement. The independent variable was gender (i.e., male and female). Results showed that there was a significant multivariate effect of gender on the combined dependent variables [Wilk's $\lambda = .80$, $F_{(2,191)} = 23.74$, $p < .0001$]. There was a large association both between the dependent variables and the gender ($\eta^2 = .20$, Power = 1.00). The results of the univariate *F* analyses indicated that there were significant gender differences on both the mathematics achievement [$F_{(1,194)} = 47.62$, $p < .0001$, $\eta^2 = .20$, Power = 1.00] and the geometry achievement [$F_{(1,194)} = 17.17$, $p < .0001$, $\eta^2 = .08$, Power = .99]. As Table 2 shows, women achieved significantly higher than men.

Table 2

Means and Standard Deviations of the Variables According to Gender

	Men (n = 96)		Women (n = 98)	
	Mean	*SD*	Mean	*SD*
Mathematics Achievement	59.70	19.24	76.56	14.52
Geometry Achievement	70.60	14.07	78.31	11.74
Positive Self-efficacy Beliefs	43.85	7.69	42.15	9.50
Application of Geometry Knowledge	20.07	4.47	19.12	5.21
Positive Self-efficacy Beliefs	18.07	5.81	17.27	6.13

A second one-way, between-subjects MANOVA was performed on the three dependent variables that were the subscales of the SESTG: Positive self-efficacy beliefs, the application of geometry knowledge, and negative self-efficacy beliefs. The independent variable was gender (male and female). Results showed that there was not any significant multivariate effect of gender on the combined dependent variables [Wilk's $\lambda = .98$, $F_{(2,190)} = 1.49$, $p < .22$]. Because omnibus MANOVA did not show any significant effect of gender, univariate *F*s were not investigated. Table 2 shows that men scored higher on all the subscales of the SESTG; however, the differences were not statistically significant.

Discussion and Conclusions

Variables that may have an effect on mathematics or geometry achievement are multi-faceted. The present study focused on only one of such variables, namely gender. We investigated the relationship between self-efficacy beliefs in geometry and geometry achievement and found that the two variables were significantly related. Similar findings have been present in literature (Bandura, 1993; Bandura, 1994; Pintrich & De Groot, 1990; Zimmerman & Bandura, 1994). In addition, a review of literature shows significant relationships between achievement in mathematics, statistics, or algebra and self-efficacy beliefs (Finney & Schraw, 2003; Hackett & Betz, 1989; Noblitt, 2006). Therefore, the findings of the study are supported in literature. It can be deduced that because of such significant relationships between self-efficacy beliefs and mathematics-related achievement, it may be important to determine students' self-efficacy beliefs in order to affect their current and future success in these areas (Bandura, 1986).

The present study also shows a significant relationship between mathematics and geometry achievement levels, which supports Lam's (1994) findings of significant positive relationships between spatial skills and geometry achievement. Similarly, Clements and Battista (1992) found significant positive relationships between spatial skills and mathematics achievement. Therefore, it can be said that higher spatial abilities are related to higher achievement in mathematics in general and geometry in particular.

Gender comparison studies in mathematics achievement usually show that men achieve higher than women (Hedges & Nowell, 1995; Peterson & Fennema, 1985; Randhawa, 1994). However, an interesting find in the study is that female students achieved higher both in mathematics and geometry compared to male students. Supporting the findings of the current study, Alkhateeb (2001) studied gender differences in mathematics achievement over a 10-year period with 2,000 high school students in the United Arab Emirates and found that female students outscored male students in the last six years of the study. In addition, Schratz (1978) found that African American and Hispanic females achieved higher in mathematics compared to men (as cited in Brandon, Newton, & Hammond, 1987). One conclusion that can be reached from these studies is that there may be cultural differences in terms of mathematics achievement. In the mainstream dominant culture, usually men show higher achievement in mathematics; however, there may be cultural as well as regional differences that may converse the results. There has been a strong emphasis in closing the gender gap in education in Turkey, and several governmental initiatives have been undertaken. Even though such efforts are relatively recent, there may be subtle influences of such efforts reflected in the results of the present study.

Işıksal and Çakıroğlu (2008) indicate that higher socio-economic status (SES) families do not believe in the superiority of males over females. They claim that such families encourage their daughters in traditionally male-dominant subjects such as mathematics. In addition, these researchers investigated gender differences in mathematics based on SES and region and found that such gender differences, if any, diminished and became non-significant in higher SES samples. Even though SES was not a variable included in the present analysis, a current study was conducted with a relatively higher SES group that revealed similar results with those of Işıksal and Çakıroğlu (2008).

Results also show that there are not any significant multivariate gender differences on the sub-scales (i.e., positive self-efficacy beliefs, application of geometry knowledge, and negative self-efficacy beliefs) of geometry self-efficacy beliefs. More recent studies show that boys and girls display similar levels of self-efficacy during elementary school years; however, starting from middle school years and continuing through high school, boys report higher self-efficacy compared to girls (Pintrich & De Groot, 1990). In fact, gender comparisons on self-efficacy research report conflicting results. For example, whereas some studies report no significant gender differences between men and women on self-efficacy (Stage & Kloosterman, 1995), Randhawa, Beamer, and Lundberg (1993) found that the self-efficacy levels of boys were higher than girls. The findings of the current study show more similarities with the results of Stage and Kloosterman (1995).

In light of these findings, we can conclude that studies should be carried out with different grade levels to gain deeper insight into the cultural factors, attitudes, and affective variables that could create gender differences related to mathematics performance, geometry performance, mathematics self-efficacy, and geometry self-efficacy. Further in-depth research studies should be carried out to explore how cultural factors, prerequisite knowledge, and demographic characters can influence the development of student self-efficacy beliefs.

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Geometri ve Matematik Başarısı ile Geometri Öz-yeterlik İnançlarında Cinsiyet Farklılıkları

(Özet)

Problem Durumu: Eğitimde bireysel farklılıkların önemi büyüktür. Matematik ve geometri gibi disiplinlerde bireysel farklılıkların önemi artmaktadır. Özellikle de bireysel farklılıklardan birisi olan cinsiyet birçok araştırmacının ilgilendiği bir değişkendir. Matematik eğitiminde cinsiyetle ilgili çalışmalarda, lise yıllarında erkeklerin matematik dersi başarılarının kızlardan daha yüksek olduğu belirtilmektedir, oysa diğer taraftan bazı çalışmalar bu farkın kapandığını göstermektedir. O halde geometri konusundaki başarı (ve yetkinlik) matematikten ayrı olarak ele alınabilir. Öğrencilerin matematik ve geometri dersi ile ilgili başarılı olmalarında bu derslere yönelik geliştirdikleri olumlu tutumda etkili olmaktadır. Öğrencilerin matematik ve geometri derslerine ilişkin geliştirdikleri olumlu tutumlar, öğrencilerin o derslere ilişkin yeterliklerini de olumlu yönde etkileyebilir. Öz-yeterlik inancı, kişilerin hangi aktiviteleri seçeceğini, bu aktiviteleri gerçekleştirebilmek için ne kadar çaba harcayacağını ve bir engelle karşılaştığında ne kadar ısrarlı davranabileceğini güçlü bir biçimde etkilemektedir. Öz-yeterlik, bireyin kendi kapasitesiyle ilgili algısı olduğundan, matematik ve geometri dersinde başarılı olan bireylerin bu derslere yönelik öz-yeterlik algılarının yüksek olması beklenir.

Araştırmanın Amacı: Bu çalışmada, öğrencilerin matematik ders başarı düzeylerindeki, geometri ders başarı düzeylerindeki ve geometriye yönelik öz-yeterlik inançlarındaki cinsiyet farklılıklarını araştırmak amaçlanmıştır.

Araştırmanın Yöntemi: Bu çalışma, gönüllü 199 lise öğrencisi üzerinde yürütülmüştür. Bu öğrencilerin 100'ü erkek ve 99'u kızdır. Öğrencilerin geometriye yönelik öz-yeterliklerini ölçmek için, öğrencilerden "Geometriye Yönelik Öz-yeterlik Ölçeği"ni tamamlamaları istenmiştir. Öğrencilerin geometri ve matematik dersindeki başarılarını belirlemek için ise, okul idaresinden dönem sonunda geometri ve matematik derslerinden almış oldukları notlar temin edilmiştir. Elde edilen veri, SPSS 10.0 paket programı kullanılarak analiz edilmiştir. Veri analizinde iki ayrı çok değişkenli varyans analizi (MANOVA) işlemi uygulanmıştır. Erkek ve kızların dönem sonu matematik ve geometri başarı farklılıklarını test etmek için gruplar arası MANOVA yapılmıştır. Ayrıca, geometri öz-yeterlik inançlarının üç alt boyutu (üç bağımlı değişken) ve cinsiyet (bağımsız değişken) arasındaki ilişkiyi test etmek için bir kez daha MANOVA kullanılmıştır.

Araştırmanın Bulguları: Aritmetik ortalama, standart sapma, değişkenler için Pearson momentler çarpımı korelasyon katsayısı ve iç tutarlık katsayısı hesaplanmış ve öz-yeterlik inançları ve geometri başarısı arasında olduğu gibi, aynı zamanda matematik ve geometri başarısı arasında da anlamlı ilişki bulunmuştur. Ayrıca matematik ve geometri başarısı (bağımlı değişkenler) ile cinsiyet (bağımsız değişken) arasındaki ilişki için gruplar arası tek yönlü MANOVA yapılmıştır. Bulgular cinsiyetin, iki bağımlı değişkenin birleşimi üzerine çok değişkenli etkisinin anlamlı olduğunu göstermiştir. Bu etkinin hangi yönde olduğunu belirlemek amacıyla yapılan F testi sonucuna göre, kızların başarıları erkeklerden anlamlı derecede yüksek bulunmuştur. Benzer biçimde geometriye yönelik öz-yeterlik ölçeğinin üç alt boyutu olan pozitif öz-yeterlik inançları, geometri bilgisinin kullanılması ve negatif öz-yeterlik inançları (bağımlı değişkenler) ile cinsiyet (bağımsız değişken) arasındaki ilişki için gruplar arası tek yönlü MANOVA yapılmıştır. Elde edilen bulgulara göre, cinsiyetin, geometri öz-yeterlik ölçeğinin alt boyutları olan bu üç bağımlı değişkenin birleşimi üzerine çok değişkenli etkisinin anlamlı olmadığı görülmüştür.

Araştırmanın Sonuçları ve Önerileri: Matematik ve geometri başarısını etkileyen değişkenler çok boyutludur. Bu çalışmada sadece cinsiyet değişkeni üzerinde durulmuştur. Bu çalışmada öğrencilerin geometriye yönelik öz-yeterlik inançları ile geometri başarıları arasında ilişki araştırılmış ve bu iki değişken arasında anlamlı ilişki bulunmuştur. Genel anlamda öz-yeterlik ile akademik başarı arasındaki ilişkinin anlamlı olduğu belirtilmektedir ve öz-yeterlik dönem sonu notları ile ilişkilidir. Öz-yeterlik ile başarı arasındaki ilişki anlamlı olduğuna göre, öğrencilerin öz-yeterlikleri hakkında bilgi edinmek onların şuandaki ve gelecekteki okul başarıları hakkında öğretmenlere önemli bilgiler sağlayacaktır.

Öğrencilerin matematik ve geometri başarıları arasında anlamlı ilişki bulunmuştur. Literatürde uzamsal yetenek ile matematik başarı arasında çok güçlü bir ilişki olduğu belirtilmektedir. Bu yüzden yüksek seviyedeki uzamsal yetenek genelde matematikteki başarı ve özelde geometrideki başarı ile sıkı ilişkilidir. Buna göre, uzamsal yeteneği yüksek olan öğrencinin matematik ve dolayısıyla geometri başarısı yüksek; uzamsal yeteneği düşük olan öğrencilerin matematik ve dolayısıyla geometri başarısı düşük olacaktır.

Bu çalışmadan elde edilen diğer bir bulgu ise öğrencilerin matematik ve geometri başarıları ile cinsiyetleri arasında kızlar lehine bir ilişkinin çıkmasıdır. Genel olarak matematik başarısındaki cinsiyet farklılıkları ile ilgili literatürde erkeklerin matematik başarıları kızlardan yüksek olduğu iddia edilmektedir. Bu genel yargıya zıt olarak bizim çalışmamızda kızların matematik ve geometri başarısı erkeklerden yüksek çıkmıştır. Kızların daha başarılı çıkmalarının nedenleri arasında kızların eğitimden daha fazla faydalanmaya başlamaları gösterilebilir. Türkiye'de özellikle az gelişmiş bölgelerde kızların eğitimi devletin büyük ilgi alanı haline gelmiştir. Matematiğin erkeklerin işi olduğu görüşü değişmeye başlamıştır. Son yıllarda, bayanlar eğitimde önemli ilerleme sağlamış ve eğitimdeki kazanımlar yönünden cinsiyet farklılığı kapanmaya başlamıştır. Sosyoekonomik düzeyi yüksek olan Türk aileler erkeklerin kızlardan daha üstün olduğuna inanmamaktadırlar. Bu yüzden bu aileler matematik gibi derslerde kızlarını cesaretlendirmektedirler. Bu çalışmanın sosyoekonomik düzeyi yüksek olan bir örneklem üzerinde yürütüldüğü göz önünde bulundurulduğunda, kızların erkeklerden daha başarılı bulunması normal karşılanabilir. Ayrıca Türk toplumunda, kız öğrenciler evde daha çok zaman geçiriyorlar ve böylece kızlar ev ödevlerine erkeklerden daha çok vakit ayırıyorlar.

Elde edilen bir diğer bulguya göre, cinsiyetin, geometri öz-yeterlik ölçeğinin alt boyutları olan pozitif öz-yeterlik inançları, geometri bilgisinin kullanılması ve negatif öz-yeterlik inançları bağımlı değişkenlerinin birleşimi üzerine çok değişkenli etkisinin anlamlı olmadığı görülmüştür. Son zamanlardaki bulgular ise erkeklerin ve kızların ilkokul yılları boyunca eşit seviyede güvene sahip olduklarını, ortaokul ve lise yıllarında ise, erkeklerin güvenlerinin daha arttığını göstermektedir. Literatürde bazı çalışmalarda matematik öz-yeterlikte cinsiyet farklılıklarına rastlanmazken, bazılarında cinsiyet farklılıkları rapor edilmiştir. Bazı araştırmacılar matematikteki cinsiyet farklılıklarının sosyokültürel faktörlerden kaynaklandığını belirtmişlerdir ve bu durum araştırmacıları öğrencilerin güvenleriyle ilgili veri toplamaya zorlamıştır.

Bu çalışmada, matematik ve geometri ders başarısında cinsiyet açısından fark bulunmuştur. Bu bağlamda, öğretmenlerin bireysel farklılıkları dikkate alarak gerekli önlemleri almaları yararlı olacaktır.

Anahtar Sözcükler: Cinsiyet farklılıkları, matematik ders başarı düzeyi, geometri ders başarı düzeyi, geometri öz-yeterlik inançları