Eğitimde Kuram ve Uygulama
Journal of Theory and Practice in Education
ISSN: 1304-9496

Articles /Makaleler
2014, 10(1): 259-278

PREDICTOR VARIABLES FOR PRIMARY SCHOOL STUDENTS RELATED TO VAN HIELE GEOMETRIC THINKING

(İLKOKUL VE ORTAOKUL ÖĞRENCİLERİNİN VAN HIELE GEOMETRİK DÜŞÜNME DÜZEYLERİNİ YORDAYAN DEĞİŞKENLER)

Ayten Pınar BAL[1]

ABSTRACT

The purpose of this study is to reveal primary school students' Van Hiele geometric thinking levels in terms of gender, attitude toward geometry and mathematics achievement. The research is a study of relational screening model. In this study, it is tried to put forward the predictive power of gender, attitude toward geometry and geometric thinking level of success in mathematics classes of primary school students. The population of the study consisted of 1270 4^{th}, 5^{th}, 6^{th} and 7^{th} grade primary school students. "Van Hiele Geometric Thinking Test" and "The Scale of Attitude toward Geometry" (SATG) were used as the data collection tool in the study. Descriptive statistics, Pearson's correlation coefficient and Multiple Regression Analysis were used in the analysis of the data obtained from the study. As a result of the study, it was concluded that geometric thinking levels of the students participated in the study is low, that attitude towards geometry is moderate and that there is a significant and moderate relationship between geometric thinking scores and attitudes. Also, it was concluded that geometric thinking scores predict attitude and success variables at moderate level, but do not affect gender variable. Based on these results, giving more importance to geometry in the primary educational programs and giving seminars for teachers of mathematics are recommended. This study is limited to primary school students. However, a similar study may be carried out within the context of secondary schools and with a wider range of samples.

Keywords: Van Hiele Geometric thinking levels, primary school, mathematics, geometrical attittude.

ÖZET

Bu çalışmanın amacı, ilköğretim öğrencilerinin cinsiyet, tutum ve akademik başarı değişkenlerinin geometrik düşünme düzeylerini ne derecede yordadıklarını ortaya çıkarmaktır. Araştırmanın çalışma grubunu Adana ili merkez ilçelerinde yer alan beş ilköğretim okulunun 4., 5. 6. ve 7. sınıflarına devam eden ve oransız küme örnekleme yöntemiyle belirlenen 1270 öğrenci oluşturmuştur. Araştırmada veri toplama aracı olarak, "Van Hiele Geometri Düşünme Testi" ve "Geometriye Yönelik Tutum Ölçeği" kullanılmıştır. Verilerin analizinde betimsel istatistik, Pearson korelasyon katsayısı ve çoklu regresyon analizi uygulanmıştır. Çalışmanın sonucunda araştırmaya katılan öğrencilerin geometri düşünme düzeylerinin düşük olduğu, geometriye yönelik tutumlarının orta düzeyde olduğu ve geometrik düşünme puanları ile tutumları arasında anlamlı ve orta düzeyde (r=.58) bir ilişki olduğu sonucuna ulaşılmıştır. Diğer taraftan geometrik düşünme puanlarının tutum ve başarı değişkenini orta düzeyde yordadığı, ancak cinsiyet değişkenini etkilemediği sonucuna ulaşılmıştır ($R=.587$ $R^2=.345$). Bu sonuçlar ışığında, özellikle ilköğretim seviyesinden başlayarak öğrencilerin, geometrik düşünme düzeylerinin ve geometriye karşı olan tutumlarının geliştirilmesine yönelik çalışmaların yapılması önerilebilir. Bu araştırma ilkokul ve ortaokul öğrencileriyle sınırlandırılmıştır. Ancak, benzer bir araştırma lise kapsamında ve daha geniş örneklem ile gerçekleştirilebilir.

Anahtar Kelimeler: Van Hiele Geometrik düşünme düzeyleri, ilköğretim, matematik, geometrik tutum.

[1] Assist. Prof. Dr. Çukurova University, Faculty of Education. **E-mail:** apinar@cu.edu.tr

INTRODUCTION

Geometry whose subject area is shapes and objects has an indispensable place in human life. Geometry has been felt in every element from science to art since the earliest times (Van De Walle, 2001). Geometry, in mathematics curriculums, provides the students with the opportunity to develop problem solving, comparison, generalization and summarization skills (Napitupulu, 2001). In this process, students especially learn how to analyze geometric shapes and the relations between them. In this regard, it provides a natural environment in the development of deduction and proving skills of students.

Geometry, in primary school mathematics curriculums, has gained great importance especially in the process of renewing the standards of National Council of Teachers of Mathematics in America (NCTM, 1989; Lehrer & Chazan, 1998). In this context, NTCM (2000) points out that the concept of geometry plays a productive role helping students to develop their habits and the ways of thinking mathematical and to interact with math. Research conducted within the context of mathematics and geometry in our country and throughout the world has especially focused on the effect of the attitude and gender over success (Yaratan & Kasapoğlu, 2012; Ganley & Vasilyeva, 2011; Marchis, 2011; Yücel & Koç, 2011; Hemmings, Grootenboer & Kay, 2010; Moenikia & Babelan, 2010; Yılmaz, Altun, Olkun, 2010; Meng, Lian & İdris, 2009; Işık, 2008; Grootenboer & Hemmings, 2007; Brodie, 2004; Wong, 1992; Haladyna, Shaughnessy & Shaughnessy, 1983). In this context, it is observed that especially these two variables predict mathematic and geometry successes significantly.

Attitude, which is considered as one of the basic emotional features affecting the learning process in education, is the reaction tendencies of people towards any object around them (Güney, 2009). According to Aiken (1996), attitude is a positive or negative reaction that has been learned previously towards a certain object, situation or an individual. Doganay (2009) emphasizes that attitude includes all the tendencies that determine how we treat people or objects. Because occurrence and development of attitudes is gradual, it continues for a while and it is gained by learning and experiencing (Tavşancıl, 2010). In this process, attitude consists of three components that are consistent with each other, which are cognitive, affective and behavioral. In the cognitive component dimension of attitude, it affects the thoughts and knowledge of the individual about the object; in the affective dimension, it affects feelings and evaluations; in the behavioral dimension, it affects the behaviors of the individual about the object (Aydın, 1990; Morgan, 1984).

Success, again in the context of education, is the set of behaviors that are consistent with the objectives developed as the product of interactions of the individual with the surroundings (Bloom, 1998). From this perspective, it is accepted that developing positive or negative attitude toward any area or learning in education affects learning that area or information significantly. According to Debellis and Goldin (2006), success depends on positive attitudes. For example, Ercikan, McCreith & Lapointe (2005), in their researches, revealed that the most

powerful predictor of success in mathematics courses is the attitudes. Again, Brodie (2004), in his study, examined the relations between the attitudes and success of prospective teachers and revealed that attitude is an important predictor in the context of success in geometry.

On the other hand, the main reason of why the gender is an important factor affecting the success is that the cultural factors are dominant over the biological factors. Although it may differ in different cultures, generally directing male students to the professions that are related to math and science topics more shows that male students are more successful in the context success in math and geometry (Erden & Akman, 2004). But again, there are studies indicating that the gender is not an important variable over the success in math and geometry or that the success is in favor of female students.

Attitude and Success in Mathematics

According to Haladyna et al. (1983), mathematical attitude is emotional willingness towards mathematics topics (numbers, geometry). Mcleod (1992) explains attitude in mathematics as the positive or negative feelings as a result of experiences.

Attitude as a predictor within the context of mathematics course has been the focus in many studies. Research conducted in this context shows that there is a positive relation especially between success in mathematics and geometry and attitude (Moenikia & Babelan, 2010; Yee, 2010; Yıldız & Turanlı, 2010; Işık, 2008; Samuelsson & Granstrom, 2007; Brodie, 2004, Peker & Mirasyedioğlu, 2003; Mogari, 1999; Ma & Kishor, 1997; Wong, 1992). For example, Mogari (1999), in his study named "Attitude and success in Euclidean geometry", determined that secondary school students had a positive attitude toward geometry and there was a moderate relationship between their success and attitude. Hemminge et al. (2010), in their studies, examined to what extend attitude, ability and gender variables predict success in mathematics. As a result of the study, it was concluded that attitudes of male students towards mathematics were more positive and their previous successes and attitudes towards mathematics predicted 69% of their success. Similarly, Yücel and Koç (2011), in the study conducted on primary school students, concluded that predictive power of attitude over the success in mathematics is 16%. In addition, Brodie (2004), in his study, examined the relationship between success in geometry, attitudes and genders of undergraduate students and revealed that attitude is an important predictor in determining the level of geometric thinking of students. To sum up, all of these studies in the literature imply that there is a positive relationship especially between success in mathematics and geometry and also attitude. In addition attitude is an important predictor in determining the geometric thinking levels of the students.

Gender and Success in Mathematics

In the literature, although there are many studies which reveal that gender is an important factor in success in mathematics and geometry, there are also many

studies which reveal that gender is not an important factor in success. While some of these studies emphasize that male students are more successful than female students in general (Ganley & Vasilyeva, 2011; Şahin 2008; Olkun, Toluk & Durmuş, 2002; Casey, Nuttall & Pezaris, 2001; Beller & Gafni, 2000; Duatepe, 2000), some of the studies emphasize that female students are more successful than male students (Erdoğan, Baloğlu & Kesici, 2011; Fidan & Türnüklü, 2010; Moenikia & Babelan, 2010; Işık, 2008; Taşdemir & Taşdemir, 2008; Timmermans, Van Lieshout & Verhoeven, 2007; Lloyd, Walsh & Yailagh, 2005; Yenilmez & Özabacı, 2003). However, there are also many studies demonstrating that gender is not an important variable in success (Oral & İlhan 2012; Karaman & Toğrol 2010, Lindberg, Hyde & Petersen, 2010; Yee, 2010; Atebe, 2008; Ekizoğlu & Tezer, 2007; Halat, 2006, 2008b; Yılmaz, Turgut & Kabakcı 2008; Işıksal & Aşkar 2005, Ai, 2002).

For example, Casey, Nuttall and Pezaris (2001), in their studies, examined geometry skills of 8th grade students in terms of gender. As a result of the study, they concluded that male students are more successful in terms of their geometry skills. On the other hand, Fidan and Türnüklü (2010), examined the level of geometric thinking of 5th grade students according to the gender variable, and they revealed that geometric thinking levels of female students are higher than the male students. On the other hand, Işıksal and Aşkar (2005) in the study they conducted over 7th grade students concluded that gender is not an important predictor. Halat (2008b), in the study in which he examined levels of geometric thinking, determined that there is not a significant difference in terms of gender.

As can be seen from the examples above, a clear conclusion cannot be reached in the studies conducted on attitude and success in mathematics and geometry.

Van Hiele Geometric Thinking

According to Van Hiele (1959) Geometry test developed by two Danish educators named Pierre Van Hiele and Dina Van Hiele-Geldof about teaching geometry, the level of geometric thinking of individuals includes five levels. Each level indicates how individuals think over the concepts in geometry and these types of thinking. In order to be at a level, the previous levels should be passed. Therefore, the levels are hierarchical. Transition between the levels depends on the subject of teaching, the quality of education and the experiences of teachers and students. The features of Van Hiele geometric thinking levels can be respectively listed as follows (Altun, 2005; Baki, 2006; Baykul, 2005; Crowley, 1987; Usiskin, 1982; Van Hiele, 1959; Van de Walle, 2001).

Level "1": Visualization/Recognition: An individual at this level can distinguish the features of shapes and classify them according to their appearance. In addition, geometric shapes and objects are perceived as a whole. Square and triangle are different from each other. "A square is a square" for an individual. They cannot comprehend the definition and features of a square depending on the definition, they

can just say the name depending on the appearance. For example, they can't notice that there is a special square or rectangular. The suitable activities that can be done with an individual at this level are generally make them play items that contain geometric shapes, make them tell their observations and experiences about these items and providing opportunities to draw these items.

Level "2": Analysis: An individual at this level can say the features of each shape in a class, but he cannot establish the relationship between these shapes. The individual at this level can reach some generalizations about shapes. For example, they can say that all the edges of a square are equal and perpendicular to each other, that the reciprocal edges of a parallel edge are equal and parallel to each other. They can classify the shapes according to their characteristics such as angle, edge. Activities such as measuring objects, identification, transforming a shape into another by disrupting, classification can be done with an individual at this level.

Level "3": Informal Deduction /Order: Individuals at this level can sort the shapes and relationships logically, but may not be able to calculate according to mathematical system. They can make simple, informal inferences, but cannot understand the proofs. They can distinguish other relations from the relations they know using informal expressions. When you say that the perpendicular edge going down from the top point of a triangle is both angle bisector and median, a student at this level can notice that this triangle is an isosceles triangle or equilateral triangle.

Level "4": Deduction: Individuals at this level can compare and discuss the feature of shapes. In addition, the individual can explain the relationships between axioms, theorems, postulate and definitions and can comprehend the processes of reasoning by induction. It corresponds to high school period.

Level "5": Rigor: Individuals at this level can notice various axiomatic systems and comprehend the relationships between them. They can interpret the non-Euclidean geometry that is not included in the mathematics program. The students at this level can deal with geometry as a science.

It should be noted that these levels that were originally defined between 0-4 within the context of Van Hiele Geometry Thinking Levels (Van de Walle, 2001; Carroll, 1998; Usiskin, 1992; Van Hiele, 1959) were defined in the form of 1-5 in later studies (Bulut & Bulut, 2012; Lie & Harun, 2011; Atebe & Schäfer, 2010; Fidan & Türnüklü, 2010; Knight, 2006; Senk, 1989). Arranging these levels of thinking in the form of 1-5 provides an opportunity to use the level of "0" for the individuals that cannot be assigned in the visual level that is the first of the levels (Knight, 2006; Senk, 1989). This level is defined by Clements and Battista (1990) as the level in which only distinguishing cornered geometric shapes from un-cornered geometric shapes is possible.

When the studies conducted on Van Hiele geometric thinking levels are examined, generally, geometric thinking levels of students (Atebe & Schäfer, 2010; Fidan & Türnüklü, 2010; Atebe, 2008; Erdogan, 2006; Napitupulu, 2001; Usiskin, 1982) and geometric thinking levels of teacher and prospective teachers (Bulut & Bulut, 2012; Oral & İlhan, 2012; Meng & Sam, 2009; Atebe, 2008; Halat, 2008a, 2008b; Knight, 2006; Toluk, Olkun & Durmuş, 2002; Duatepe, 2000), geometric

thinking levels with various teaching methods (Meng & Idris, 2012; Duatepe-Paksu & Ubuz, 2009; Meng, 2009; Akkaya, 2006; Erdogan, 2006; Johnson, 2002) and Van Hiele Geometric thinking levels with academic achievement were tested (Watson, 2012; Atebe & Schäfer, 2010; Napitupulu, 2001).

Problem Statement

With the increasing importance of teaching geometry, it has been observed that the studies conducted in mathematics programs generally focus on the factors that predict attitude or gender (Brodie; 2004, Frykholm, 1994) or focus on Van Hiele geometric thinking levels (Bulut & Bulut, 2012; Oral & İlhan, 2012; Atebe & Schäfer, 2010; Fidan & Türnüklü, 2010; Meng, 2009; Meng & Sam, 2009; Halat, 2008a, 2008b; Akkaya, 2006; Erdogan, 2006; Knight, 2006; Napitupulu, 2001). However, there is not any study that examines gender and attitudes towards geometry of especially primary school students in terms of Van Hiele geometric thinking levels. In this respect, the main objective of this study is to reveal primary school students' geometric thinking levels related to gender, attitude toward geometry and mathematics achievement. The following questions were asked in accordance with this main purpose:

1. How are the geometric thinking levels of primary school students?
2. How are the attitudes of primary school students toward geometry?
3. Does the variables gender, attitude toward geometry and mathematics achievement predict the geometric thinking levels of students in a meaningful way?

METHOD

Model of the Study

The research is a study of relational screening model. Relational screening model is a research model aimed at determining the presence and degree of the change in common between two or more variables (Gay, 1987) or predicting the results and relations between the variables (Creswell, 2008). In this study, it is tried to put forward the predictive power of gender, attitude toward geometry and geometric thinking level of success in mathematics classes of primary school students.

The Sample

The study group of the research consisted of 1270 4^{th}, 5^{th}, 6^{th} and 7^{th} grade students determined by the disproportionate cluster sampling method from five primary schools located in Adana. The demographic data of the participants is presented in Table 1

Table 1. Demographic Data of the Participants

Variables		f	%
Gender	Female	637	50.2
	Male	633	49.8
Classroom Level	Fourth Grade	256	20.2
	Fifth Grade	368	29
	Sixth Grade	304	24
	Seventh Grade	342	26.8

When Table 1 is examined it can be seen that the 50.2% (637) of the students is female and 49.8% (633) is male and 20.2% (256) is fourth grade, 29% (368) is fifth grade, 24% (304) is sixth grade and 25.3% (342) is seventh grade students.

Data Collection

"Van Hiele Geometric Thinking Test" and "Attitude Scale towards Geometry" were used as the data collection tool in the study. Information on the measurement tools mentioned is listed below in sub-titles.

Van Hiele Geometric Thinking Test: "Van Hiele Geometric Thinking Test" developed by Usiskin (1982) and whose Turkish adaptation, reliability and validity were performed by Duatepe (2000) was used in order to determine the geometric thinking levels of the students participated in the study. This test includes five hierarchical levels. For each test, Cronbach Alpha reliability coefficient ranges from .69 to .79 in Usiskin's data; from .59 to .82 in Duatepe's (2000) data; and from .55 to .72 in the data of this study.

This test includes five questions for each thinking level and a total of 25 multiple choice questions. The first five questions represent the 1st level, the second five questions represent the 2nd level, the third five questions represent the 3rd level, the fourth five questions represent the 4th level and the fifth five questions represent the 5th level. A student has to answer correctly at least three of the five questions in order to be assigned to a certain level (Usiskin, 1982). The scoring system designed by Usiskin (1982) was used in the determination of geometric thinking levels. According to this scoring system, predominantly scores were calculated taken from each level (Usiskin, 1982; Knight, 2006):

0. The ones who cannot answer correctly three or more questions in any level get 0 points,

1. The ones who answers correctly the questions 1-5 of the level and provide the criteria get 1 point,

2. The ones who answers correctly the questions 6-10 of the level and provide the criteria get 2 points,

3. The ones who answers correctly the questions 11-15 of the level and provide the criteria get 4 points,

4. The ones who answers correctly the questions 16-20 of the level and provide the criteria get 8 points,

5. The ones who answers correctly the questions 20-25 of the level and provide the criteria get 16 points.

Accordingly, a student can take maximum 1 point for the first level, 3 points for the second level, 7 points for the third level, 15 points for the fourth level and 31 points for the fifth level. Because the geometric thinking levels of primary school students are expected to be maximum in the third level (Atebe, 2008; Pickreign & Capps, 2000; Mistretta, 2000), the top level that the study group can reach is the "3rd Level" and thus, first 15 questions were evaluated. These levels should be achieved respectively and depend on the teaching process more than age and maturity of the learners.

The Scale of Attitude toward Geometry: In the study, the scale of attitude towards geometry consists of twelve items in order to determine the attitudes of primary school students towards geometry (Duatepe, 2004). These sub-factors are *Interest/Enjoyments* and *Confidence/Anxiety*. The scale of attitude towards geometry is evaluated on 5 point Likert Scale (1-totally disagree, 5-totally agree). The lowest point that can be achieved is 12 and the highest point that can be achieved is 60 in the total. While disturbing the points the students are categorized as: 5.00-4.21 “totally agree”; 4.20-3.41 “agree”; 3.40-2.61 “unstable”; 2.60-1.81 “disagree” and 1.80-1.00 “totally disagree”.

Originally, in her study, Duatepe (2004) ranges Cronbach Alpha reliability coefficient from 0.70 to 0.91. However, the Cronbach Alpha for this study is calculated as .82 and .79 respectively.

Success in Mathematics: Success in mathematics was taken as the third variable in the study. In this context, the students’ mark related to 2011-2012 academic year was taken into consideration. Accordingly, the grades of success are between the reference range "5-Well", "4-Good", "3-Middle", "2-Pass", and "1-Fail" (Ministry of Education, 2007).

Data Collection

In the research, data were collected in the spring semester of 2011-2012 academic year. The school administrators, the students and teachers participated in this study was informed briefly about the purpose of the study and data collection tools. The study was applied to the students who volunteered. The implications were carried out by the researcher and continued approximately for one lesson hour (40 minutes).

Data Analysis

Descriptive statistics were used in the analysis of the data obtained from the study. In addition, the relationship between geometric thinking points and genders of the students and their attitudes towards geometry were analyzed by Pearson's correlation coefficient. Additionally, multiple regression analysis was performed in order to determine to what extent the attitude toward geometry and gender variables predict the levels of geometric thinking. Whether the necessary assumptions were

provided or not was checked before starting the Multiple Regression Analysis and it was determined as a result of the analyzes that multicollinearity and autocorrelation problem did not exist. Because of the fact that the binary correlation values of the independent values are under .80, that VIF values are less than 10, that tolerance values are greater than 20 ad CIS are less than 30, it was concluded that multicollinearity didn't exist. In addition, because of the fact that Durbin-Watson values are between the values 0-2, it was concluded that there were not any autocorrelation (Tabachnick & Fidell, 2001). Standard regression method was used in the analysis of multiple regressions.

RESULTS

The findings obtained from the analysis of the data in accordance with the given order of sub-problems in this part of the study. The distribution related to the geometric thinking levels of primary school students participated in the study was given in Table 2.

Table 2. The Distribution Related To the Geometric Thinking Levels of Students

Geometric Thinking Levels	**N**	**%**
0*	819	64.5
1	335	26.4
2	82	6.5
3	34	2.7
Total	1270	100

*: Level 0: In the study, it is accepted as the level in which the students who cannot provide the criteria required for any level.

When Table 2 is examined, it is seen that 64.5% of the students are at level "0". Accordingly, it can be said that the students were not able to answer three questions out of five correctly in any level. In addition, it is seen that approximately one-quarter (26.4 %) of the students are at level "1".

he distribution related to the attitudes of the students towards geometry participated in the study was given in Table 3.

Table 3. Arithmetic Mean and Standard Deviation Values related to the attitudes of the Students towards Geometry

Sub-Factors of Attitudes Towards Geometry	**N**	$\bar{X}$	**S**
Interest/Enjoyment	1270	3.58	1.07
Confidence/Anxiety	1270	3.72	1.04
Total	1270	3.08	1.63

When Table 3 is examined, it can be seen that the arithmetic mean value related to the "Interest/Enjoyment" scale is 3.58, the arithmetic mean value related to the "Confidence/Anxiety" scale is 3.72 and the arithmetic mean value related to the whole of the scale is 3.08. Accordingly, it can be said that the views related to "Anxiety" corresponds to "I agree" and views related to "Interest/Enjoyment" and the whole of the scale corresponds to "unstable".

Multiple regression analysis was used in order to determine to what extent the attitudes towards geometry, academic achievement and gender independent variables predict geometric thinking points. Before making the multiple regression analysis, Pearson correlation coefficients were calculated in order to reveal the relationship between the dependent and independent values and these values were given in Table 4.

Table 4. The Results of Correlation Analysis between Geometric Thinking Points of Students and Attitudes towards Geometry, and Academic Achievement and Gender

	Geometric Thinking Points	Attitudes Towards Geometry	Fail	Pass	Middle	Good	Well	Gender
Geometric Thinking Points	1	.582**	-.082**	-.026	.009	-.015	.134**	.065*
Attitudes Towards Geometry	-	1	-.074**	-.059*	-.032	-.011	.180**	.108**
Fail	-	-	1	-.064*	-.102**	-.141**	-.191**	-.025
Pass	-	-	-	1	-.116**	-.162**	-.218**	-.020
Middle	-	-	-	-	1	-.257**	-.346**	-.004
Good	-	-	-	-	-	1	-.482**	.007
Well	-	-	-	-	-	-	1	.007
Gender	.-	-	-	-	-	-	-	1

*:p<.05; **:p<.001; ***:Fail: the ones achieved 1; Pass: the ones achieved 2; Middle: the ones achieved 3; Good: the ones achieved 4; Well: the ones achieved 5.

When Table 4 is examined, it is seen that there is a positive, moderate (r=.58) relationship between geometric thinking point and attitudes towards geometry and a low level relationship between other variables. Accordingly, the fact that the correlation of independent variables with the dependent variables is significant and the relationship between the independent variables is high, as Büyüköztürk (2006) stated; not higher than 0.80, is the indication of that independents variables can be taken to regression analysis.

On the other hand, when the relationship between independent variables such as attitude, success and gender are examined, it is observed that there is a positive

low level relationship between attitude and gender. The fact that there isn't any significant relationship between gender and success is given in Table 4.

Multiple regression analysis was performed in order to determine the predictive power of attitude, academic achievement and gender variables on geometric thinking points. The results of the analysis are given in Table 5.

Table 5. Results of the Regression Analysis of the Factors Affecting Geometric Thinking

Variable	B	Std. error	Beta(β)	t	p	Zero-order	Partial
Constant	1.427	.253		5.643	.000		
Attitudes Towards Geometry	.909	.038	.568	24.047	.000	.582	.561
*Fail	.122	.351	.010	.347	.729	-.082	.010
Pass	.631	.329	.061	1.918	.055	-.026	.054
Middle	.726	.281	.100	2.583	.010	.009	.073
Good	.520	.264	.087	1.968	.049	-.015	.055
Well	.662	.258	.123	2.568	.010	.134	.072
Gender	.031	.121	.006	.261	.795	.067	.007

R=.587 R^2=.345 Adjusted R^2=.341
F(7-1256)=214.224 p<.01

*Fail: the ones achieved 1; Pass: the ones achieved 2; Middle: the ones achieved 3; Good: the ones achieved 4; Well: the ones achieved 5.

As can be seen clearly in Table 5, there is a significant moderate relationship between attitude towards geometry, academic achievement and gender variables and geometric thinking points. (R=.587 R^2=.345, F (7-1256) =214.224, p<.01) These variables explain 34% of the total variance in geometric thinking points of students.

According to the standardized regression coefficients (β), the relative importance sequence of predictive variables on geometric thinking levels is: attitude towards geometry, success in mathematics and gender. When the results of t test related to the significance of regression coefficients, it is observed that attitude towards geometry and success in mathematics predict geometric thinking significantly; that gender is not a significant predictor on thinking levels. In this case, it is possible to say that attitude and success are more effective variables on geometric thinking.

DISCUSSION AND CONCLUSION

In this study, the relationship between geometric thinking levels, attitudes, academic achievements and genders of primary school students and how these variables are predicted are tried to be explained. As a result of the study, it was concluded that geometric thinking levels of the students participated in the study is

low, that attitude towards geometry is moderate and that there is a significant and moderate (r=.58) relationship between geometric thinking points and attitudes.

In the study, firstly the Van Hiele geometric thinking levels are examined, it was concluded that 64.5% of the students were not assigned to any level "0", 26.4 % of the students were at level 1 (Visualization/ Recognition), 6.5% of the students were at level 2 (Analysis) and 2.5% of the students were at level 3 (Informal Deduction /Order). In this case, it is concluded that primary school students are at various geometric thinking levels and there are students at every levels even if the rates are different. Similar results were obtained from the studies conducted on this subject (Watson, 2012, Oral & İlhan, 2012; Fidan & Türnüklü 2010, Atebe, 2008; Carroll, 1998). However, according to the National Council of Teachers of Mathematics (NCTM, 2000), primary school students should be at level 2 (Atebe, 2008; Halat, 2006; Altun, 2005; Usiskin, 1982).

Similarly, in other studies conducted, it is observed that geometric thinking levels expected from students are low (Oral & İlhan, 2012; Watson, 2012; Lie & Harun, 2011; Atebe & Schäfer, 2010; Fidan & Türnüklü 2010; Yıldız &Turanlı, 2010; Meng & Sam, 2009; Atebe, 2008; Yılmaz, Turgut, Kabakcı, 2008; Duatepe, 2000; Sandt, 2007; Erdogan, 2006; Halat, 2006; Knight, 2006; Mistretta, 2000; Carroll, 1998; Ahuja, 1996; Usiskin, 1982). For example, Caroll, as a result of his study in which he examined Van Hiele geometric thinking levels of primary school students, concluded that 46% of 5th grade students are at level "0", 41% are at level "1", 13% are at level "2". Usiskin (1982) stated that geometric levels of 60% of the students who begin high school education are at level 0 and 1. Similarly, Lie & Harun (2011), pointed out that majority of the primary school students whose average age is 14 are at level 1 of Van Hiele geometric thinking levels.

From the perspective of attitude, it is observed that the students are at high level to the "Interest/Enjoyment" and "Confidence/Anxiety" factors but they are at moderate level in terms of the total score. This result is parallel with the studies of Aktas & Aktas (2012), Dede (2012), Yücel & Koç (2011), Özkeleş-Çağlayan (2010), Işık (2008), Ekizoğlu & Tezer, (2007), Bindak (2004), and Peker & Mirasyedioğlu (2003).

Another important result obtained from the study is that there is not a significant relationship between the gender and geometric thinking variables. Accordingly, we can say that geometric thinking points of male and female students are close to each other. This finding resembles with the studies conducted by Oral & İlhan (2012), Halat (2006, 2008b) and Yılmaz, Turgut & Kabakcı (2008). However, in contrast to this finding, while Şahin (2008), Atebe (2008), Erdogan, (2006), Olkun, Toluk & Durmuş (2002), Duatepe (2000), and Ma (1995) reach to a significant difference statistically in favor of male students in terms of geometric thinking levels, Fidan and Türnüklü (2010) reached a significant difference in favor of female students. As it is clearly seen in these findings, there is not a common conclusion related to the relationship between gender and geometric thinking level in the studies. In this case, it can be said that the gender variable is not an effective factor in terms of geometric thinking.

As the final purpose in the study, it was concluded that geometric thinking points predict attitude and success variables at moderate level, but do not affect gender variable (R=.587 R^2=.345). This result is parallel with the study of Frykholm (1994) and Brodie (2004). Frykholm, in his study, concluded that geometric thinking levels of 8^{th}, 9^{th}, 10^{th} and 11^{th} grade students predict age, gender, class grade, success test, geometry test predictor variables significantly.

Geometry, whose subject field is shapes and objects, plays an important role especially in the developments of problem solving, comparison, generalization and summarization skill of the students. Using the relationships of especially geometric shapes with each other and the analysis methods of these shapes in geometry teaching is of great importance for the development of conclusion and proving skills of the students.

Research conducted within the context of mathematics and geometry in the literature focuses on the effect of especially attitude and gender variables on success (Yaratan & Kasapoğlu, 2012; Ganley & Vasilyeva, 2011; Marchis, 2011; Hemmings, et al., 2010; Moenikia & Babelan, 2010; Meng, et al., 2009; Işık, 2008; Grootenboer & Hemmings, 2007; Brodie, 2004). In this context, it is observed that especially these two variables predict success in mathematics and geometry significantly.

The findings obtained from this study indicate the similar results. In this context, it can be concluded that the students gathered in different geometric thinking levels, but very few of them are at the geometric thinking level expected from them. In addition, another important finding obtained from the study is that the attitudes of students towards geometry are moderate and there is a moderate level of relationship between geometric thinking levels and attitudes. In addition, it is observed clearly in the study that geometric thinking levels predict attitude towards geometry and success in mathematics at a moderate level.

Based on these results, teachers play an important role in the development of geometric thinking levels and attitudes towards geometry of students especially starting from primary levels. In this context, giving more importance to geometry in the primary educational programs and giving seminars for teachers of mathematics are recommended. This study is limited to primary school students. However, a similar study may be carried out within the context of secondary schools and with a wider range of samples.

REFERENCES

Ahuja, O. P. (1996). An investigation in the geometric understanding among elementary pre-service teachers. Paper presented at the ERA-AARE Conference, Singapore, 29 November. Retrieved May 13, 2011 from www.aare.edu.au/96pap/ahujo96485.txt

Ai, X. (2002). Gender differences in growth in mathematics achievement: Three-level longitudinal and multilevel analyses of individual, home, and school influences. *Mathematical Thinking and Learning*, *4*(1), 1–22.

Aiken, L. R. (1996). *Rating scales and checklists: Evaluating behavior, personality, and attitudes.* New York, NY: John Wiley.

Akkaya, S., C. (2006). *Van Hiele düzeylerine göre hazırlanan etkinliklerin ilköğretim 6.sınıf öğrencilerinin tutumuna ve başarısına etkisi*. Unpublished master thesis, University of Abant İzzet Baysal Üniversitesi, Bolu, Turkey.

Aktaş, M. C. & Aktaş, D. Y. (2012). Lise Öğrencilerinin Geometriye Karşı Tutumlarının Çeşitli Değişkenlere Gore İncelenmesi: Ordu İli Ornegi. *Dicle Üniversitesi Ziya Gokalp Egitim Fakultesi Dergisi*, 156(18),156-16.

Altun, M. (2005). *Egitim fakülteleri ve ilköğretim matematik öğretmenleri için matematik öğretimi*. Bursa: Erkam Matbacılık.

Atebe, H. U. (2008). Students' Van Hiele levels of geometric thought and conception in plane geometry: A collective case study of Nigeria and South Africa. Unpublished doctoral thesis, University of Rhodes, Grahamstown.

Atebe, H. U., Schäfer, M. (2010). Research evidence on geometric thinking level hierarchies and their relationships with students' mathematical performance. *Journal of the Science Teachers Association of Nigeria*, 45(1-2), 76-84.

Aydın, O. (1990). Tutumlar. In E. Ozkalp (Ed.) *Davranis Bilimlerine Giriş*. (293-307). Eskisehir: Anadolu Üniversitesi Yayinlari No: 107

Baki, A., (2006). *Kuramdan uygulamaya matematik eğitimi*. Trabzon: Derya Kitabevi.

Baykul, Y. (2005). *İlköğretim matematik öğretimi (1-5 Sınıflar)*. (8. Baskı). Ankara: PegemA Yayınları.

Beller, M. Gafni, N. (2000). Can item format (multiple choice vs. open- ended) account for gender differences in mathematics achievement? *Sex Roles*, 42(1/2),1-21.

Bindak, R. (2004). *Geometri tutum ölçeği güvenirlik geçerlik çalışması ve bir uygulama***.** Unpublished doctoral dissertation, University of Dicle, Diyarbakır, Turkey.

Bloom, B. S. (1998). *İnsan nitelikleri ve okulda öğrenme*. (Cev. D. A. Özçelik). İstanbul: Milli Egitim Basımevi.

Brodie, J. H. (2004). Background factors affecting success in geometry. Unpublished doctoral dissertation, University of Western Sydney. Retrieved October 7, 2012, from http://arrow.uws.edu.au:8080/vital/access/manager/Repository/uws:2401.

Bulut, N. & Bulut, M. (2012). Development of pre-service elementary mathematics teachers' geometric thinking levels through an undergraduate geometry course. *Procedia - Social and Behavioral Sciences 46, 760 – 763*.

Büyüköztürk, S. (2006). *Sosyal bilimler için veri analiz el kitabi* (6. baskı). Ankara: Pegem A Yayıncılık.

Carroll, W. M.(1998). Geometric knowledge of middle school students in a reform based mathematics curriculum. *School Science and Mathematics*, 98(4). 188-197.

Casey, M. B., Nuttall, R. L., & Pezaris, E. (2001). Spatial–mechanical reasoning skills versus mathematics self-confidence as mediators of gender differences

on mathematics subtests using cross-national gender-based items. Journal for Research in Mathematics Education, 32(1), 28– 57.

Clements, D., & Battista, M. (1990). The effects of logo on children's conceptualizations of angle and polygons. *Journal for Research in Mathematics Education, 21*(5), 356-371.

Creswell, J.W. (2008). *Educational research: planning, conducting and evaluating quantative and qualitative research,* (3nd ed.). Upper Saddle River, NJ: Pearson Education, Inc.

Crowley, M. L. (1987). The Van Hiele model of the development of geometric thought. In M.M. Lindquist, Ed., *Learning and teaching geometry, K-12* (pp. 1-16). Reston, VA: National Council of Teachers of Mathematics.

Debellis, V. A. & Goldin, G. A. (2006). Affect and meta-affect in mathematical problem solving: a representational perspective. *Educational Studies in Mathematics*, 63: 131–147.

Dede, Y. (2012). Students' attitudes towards geometry: a cross-sectional study. *International Journal for Studies in Mathematics Education*, 5(1), 85-113.

Doganay, A. (2009). Değerler eğitimi. (Ed. C. Öztürk). *Sosyal bilgiler öğretimi, demokratik vatandaşlık eğitimi* (225-257). Ankara: PegemA yayınevi.

Duatepe, A. (2000). An Investigation on the relationship between Van Hiele Geometric level of thinking and demographic variables for preservice elementary school teachers. Unpublished master thesis, University of Orta Dogu Teknik, Ankara, Turkey.

Duatepe, Asuman. (2004). Drama temelli öğretimin yedinci sınıf öğrencilerinin geometri başarısına, Van Hiele geometrik düşünme düzeylerine, matematiğe ve geometriye karşı tutumlarına etkisi. Unpublished doctoral dissertation, University of Orta Dogu Teknik, Ankara, Turkey.

Duatepe-Paksu, A. & Ubuz, B. (2009). Effects of drama-based geometry instruction on student achievement, attitudes, and thinking levels. *The Journal of Educational Research*, 102(4), 272-286.

Ekizoğlu, N. & Tezer, M. (2007). İlköğretim öğrencilerinin matematik dersine yönelik tutumları ile matematik basari puanları arasındaki ilişki. Retrieved May 11, 2011, from http://www.world-education-center.org/index.php/cjes/article/viewFile/27/24

Ercikan, K. McCreith, T. & Lapointe, V. (2005). Factors associated with mathematics achievement and participation in advanced mathematics courses: an examination of gender differences from an international perspective. *School Science and Mathematics***,** 105(1), 5-14.

Erden, M. & Akman, Y. (2004). *Gelişim ve öğrenme* (13.ed.). Ankara: Arkadaş Yayınevi

Erdogan, T. (2006). *Van Hiele modeline dayalı öğretim surecinin sınıf öğretmenliği öğretmen adaylarının yeni geometri konularına yönelik hazır bulunuşluk düzeylerine etkisi*. Unpublished master thesis, University of Abant İzzet Baysal, Bolu, Turkey.

Fidan Y. & Türnüklü, E. (2010). İlköğretim 5. sınıf öğrencilerinin geometrik düşünme düzeylerinin bazı değişkenler açısından incelenmesi. *Pamukkale Üniversitesi Egitim Fakultesi Dergisi*, 27, 185-197.

Frykholm, J. A. (1994). *External variables as predictors of the Van Hiele levels in and geometry students* (ERIC Document Reproduction Service No. ED372924). Retrieved May 4, 2012 from http://www.eric.ed.gov/ERICWebPortal/contentdelivery/servlet/ERICServlet?accno=ED372924.

Ganley C. M. & Vasilyeva, M. (2011). Sex differences in the relation between math performance, spatial skills, and attitudes. *Journal of Applied Developmental Psychology*, 32 (2011) 235–242.

Gay, L. R. (1987). Educational research: Competencies for analysis and application (3rd ed.). Columbus, OH: Merrill.

Grootenboer, P. & Hemmings, B. (2007). Mathematics performance and the role played by affective and background factors. *Mathematics Education Research Journal*, 19(3). 3-20.

Güney, S. (2009). Davranış bilimlerine giris. Ankara: Nobel Yayıncılık.

Haladyna, T., Shaughnessy, J., & Shaughnessy, J. M. (1983). A causal analysis of attitude toward mathematics. *Journal for Research in Mathematics Education*, 14(1), 19-29.

Halat, E. (2006). Sex-related differences in the acquisition of the van hiele levels and motivation in learning geometry. *Asia Pacific Education Review*, 7(2), 173-183.

Halat, E. (2008a). Pre-Service elementary school and secondary mathematics teachers' van hiele levels and gender differences. *The Journal*. 1, (Content Knowledge), Retrieved October 12, 2011, from www.k-12prep.math.ttu.edu

Halat, E. (2008b). In-service middle and high school mathematics teachers: geometric reasoning stages and gender. *The Mathematics Educator*, 18(1), 8-14.

Hemmings, B., Grootenboer, P. & Kay, R. (2010). Predicting mathematics achievement: the influence of prior achievement and attitudes. *International Journal of Science and Mathematics Education*, 9, 691-705.

Işık, E. (2008). Predicting 9th grade students' geometry achievement: Contributions of cognitive style, spatial ability and attitude toward geometry. Unpublished master's thesis, Middle East Technical University, Ankara, Turkey.

Işıksal, M. & Aşkar, P. (2005). The effect of spreadsheet and dynamic geometry software on the achievement and self-efficacy of 7th-grade students. *Educational Research*, 47(3), 333-350.

Işıksal, M. & Çakıroğlu, E. (2008). Gender Differences Regarding Mathematics Achievement: The Case of Turkish Middle School Students. *School Science and Mathematics*, 180(3), 113-120.

Johnson, C. D. (2002). The effects of the geometer's Sketchpad on the Van Hiele levels and academic achievement of high school students. Unpublished doctoral dissertation, University of Wayne State, Detroit, Michigan.

Karaman, T., Toğrol, A. Y. (2010). Relationship between gender, spatial visualization, spatial orientation, flexibility of closure abilities and performance related to plane geometry subject among sixth grade students. *Bogazici University Journal education,* 26(1), 1-25.

Knight, K. C. (2006). An investigation into the change in the Van Hiele levels of understanding geometry of pre-service elementary and secondary mathematics teachers. Unpublished m*aster thesis, University of* Maine, Lincoln.

Lehrer, R. & Chazan, D. (1998). *Designing learning environments for developing understanding of geometry and space*. Mahwah, NJ: Lawrence Erlbaum Associates.

Lie, K. M. Harun, H. (2011). Malaysian students' achievement in solid geometry. *Recent Researches in Education,* Retrieved May 12, 2012, from http://www.wseas.us/elibrary/conferences/2011/Penang/EDU/EDU-22.pdf

Lindberg, S. M., Hyde, J. S. & Petersen, J. L. (2010). New Trends in Gender and Mathematics Performance: A Meta-Analysis, *Psychol Bull,* 136(6), 1123–1135.

Lloyd, J. E. V., Walsh, J., & Yailagh, M. S. (2005). Sex differences in performance attributions, self-efficacy, and achievement in mathematics: If I'm so smart, why don't I know it?. *Canadian Journal of Education, 28*(3), 384-408.

Ma, X. (1995). Gender differences in mathematics achievement between Canadian and Asian education systems. *The Journal of Educational Research, 89*, 118-126.

Marchis, I. (2011). Factors that influence secondary school students attitude to Mathematics. *Procedia Social and Behavior*.29, 786-793.

McLeod, D. B. (1992). Research on affect in mathematics education: a reconceptualization (pp. 575-596). In D.A. Grouws (Ed.) *Handbook of research on mathematics learning and teaching,* Macmillan, New York.

Meng, C. C. & Idris, N. (2012). Enhancing students' geometric thinking and achievement in solid geometry. *Journal of Mathematics Education*, 5(1). 15-33.

Meng, C. C. (2009). Enhancing students' geometric thinking through phase based instruction using geometer's sketchpad: A case study. *Journal Pendidik dan Pendidikan*. 24, 89-107.

Meng, C. C. & Sam, L. C. (2009). Assessing pre-service secondary mathematics teachers' geometric thinking. *Asian Mathematical Conference, Malaysia 2009*. [Online]: Retrieved May 25, 2011, from http://www.mat.usm.my/AMC%202009%20Proceedings/Stats/Miscellaneous/P478.pdf

Meng, C., C., Lian, L., H. & Idris, N. (2009). Pre service secondary mathemetics teachers' geometric thinking and course grade. Retrieved April 10, 2011 from http://www.recsam.edu.my/cosmed/cosmed09/AbstractsFullPapers2009/Abstract/Mathematics%20Parallel%20PDF/Full%20Paper/M07.pdf.

Mistretta, R. M. (2000). Enchancing geometric reasoning. *Adolescence*, 35(138),365-379.

Moenikia, M. & Babelan, A. Z. (2010). A study of simple and multiple relations between mathematics attitude, academic motivation and intelligence quotient with mathematics achievement. *Procedia Social and Behavioral Sciences*, 2, 1537–1542.

Mogari, D. (1999). Attitude and achievement in euclidean geometry. Retrieved April 11, 2012, from http://math.unipa.it/~grim/EMogari9.PDF

Morgan, C. T. (1984). Psikolojiye giris ders kitabi (3rd ed.). (Çev: S. Karakaş). Ankara: Meteksan LTD. Sti.

Napitupulu, B. (2001). *An exploration of students' understanding and Van Hieles of thinking on geometric constructions.* Unpublished master dissertation, Simon Fraser University, Canada.

NCTM, (2000). *Principles and standarts for school mathematics.* Reston, VA: National Council of Teachers of Mathematics.

Olkun, S., Toluk, Z. & Durmuş, S. (2002). Sinif ogretmenligi ve matematik ogretmenligi ogrencilerinin geometrik dusunme düzeyleri. *V. Ulusal Fen Bilimleri ve Matematik Egitimi Kongresi 16-18 Eylul 2002* (p. 1064-1070). Ankara: Devlet Kitapları Basimevi Mudurlugu.

Oral, B. & İlhan, M. (2012). İlkogretim ve ortaogretim matematik ogretmen adaylarının geometrik dusunme düzeylerinin cesitli degiskenler acısından incelenmesi. *Necatibey Egitim Fakultesi Elektronik Fen ve Matematik Egitimi Dergisi (EFMED)*, 6(1), 201-219.

Özkeleş-Çağlayan, S. (2010). Lise 1. sınıf ogrencilerinin geometri dersine yonelik ozyeterlik algısı ve tutumunun geometri dersi akademik basarısını yordama gucu. Unpublished master thesis, University of Yıldız Teknik, Istanbul, Turkey.

Peker, M. & Mirasyedioğlu, S. (2003). Lise 2. sınıf ogrencilerinin matematik dersine yonelik tutumları ve basarıları arasındaki iliski. *Pamukkale Üniversitesi Egitim Fakultesi Dergisi*, 14 (2), 157-166.

Pickreign, J. & Capps, L. R. (2000). Alignment of elementary geometry curriculum with current standards. *Elementary Geometry Curriculum*. 100(5). 243-251.

Samuelsson, J. & Granstrom, K.(2007). Important prerequisites for students' mathematical achievement. *Journal of Theory and Practice in Education,* 3 (2), 150-170.

Sandt, S. V. D., (2007). Pre-Service geometry education in South Africa: A Typical Case. The Journal, 1, (Content Knowledge), Retrieved May 7, 2011 from http://www.k12prep.math.ttu.edu/journal/contentknowledge/sandt01/article.pdf

Senk, S. L. (1989). Van Hiele Levels and achievement in writing geometry proofs. *Journal for Research in Mathematics Education*, 20(3), 309–321.

Şahin, O. (2006). *Sınıf öğretmenlerinin ve sınıf öğretmeni adaylarının Van Hiele geometrik düşünme düzeyleri.* Unpublished master thesis, University of Afyon Kocatepe, Afyon, Turkey.

Tabachnick, B. G .& Fidell, L. S. (2001). *Using Multivariate Statistics* (4th ed.) Boston: Allyn and Bacon.

Taşdemir, M. & Taşdemir, A. (2008). A comparison of Turkish primary school students' achievement in science and maths subjects. *Journal of Qafqaz University, 22*(2). 190-198.

Tavşancıl, E. (2010). *Tutumların ölçülmesi ve SPSS ile veri analizi*. (4. Baskı). Ankara: Nobel Yayın Dağıtım.

Timmermans, R. E. ,Van Lieshout, E. C. D. M. & Verhoeven, L. (2007). Gender-related effects of contemporary math instruction for low performers on problem-solving behavior. *Learning and Instruction*,17(1), 42-54.

Toluk ,Z., Olkun, S. & Durmuş, S. (2002). Problem merkezli ve görsel modellerle destekli geometri öğretiminin sınıf öğretmenliği öğrencilerinin geometrik düşünme düzeylerinin gelişimine etkisi. *V. Ulusal Fen Bilimleri ve Matematik Eğitimi Kongresi 16-18 Eylul 2002* (p. 1118-1123). Ankara: Devlet Kitapları Basımevi Mudurlugu.

Usiskin, Z. (1982). *Van Hiele levels and achievement in secondary school geometry*. (Final report, cognitive development and achievement in secondary school geometry project). Retrieved May 10, 2012, from http://ucsmp.uchicago.edu/resources/van_hiele_levels.pdf

Van De Walle, J. A. (2001). *Elementary and Middle School Mathematics: Teaching Developmentally* (4th.ed.). Boston: Allyn and Bacon.

Van Hiele, P. H. (1959). Levels of mental development in geometry. Retrieved October 10, 2012, from http://www.math.uiuc.edu/~castelln/VanHiele.pdf.

Watson, C. (2012). A comparison of Van Hiele levels and final exam grades of students at the University of Southern Mississippi. *Honors Theses.* Paper 88. Retrieved October 2, 2012, from http://aquila.usm.edu/honors_theses.

Wong, N. (1992). The relationship among mathematics achievement, affective variables and home background. *Mathematics Education Research Journal, 4(3), 32-42.*

Yaratan, H. & Kasapoğlu, L. (2012). Eighth grade students' attitude, anxiety, and achievement pertaining to mathematics lessons. *Procedia Social and Behavioral Sciences*, 46(2012), 162 – 171.

Yee, L. S. (2010). Mathematics attitudes and achievement of junior college students in Singapore. Retrieved May 30, 2011, from http://www.merga.net.au/documents/MERGA33_Lim.pdf

Yenilmez, K. & Ozabacı, N. S. (2003). Yatılı öğretmen okulu öğrencilerinin matematik ile ilgili tutumları ve matematik kaygı düzeyleri arasındaki iliski üzerine bir araştırma. *Pamukkale Üniversitesi Egitim Fakültesi Dergisi*, 14(2), 132-146.

Yıldız, S. & Turanlı, N. (2010). Öğrenci seçme sınavına hazırlanan öğrencilerin matematik dersine yönelik tutumlarının belirlenmesi. *Selcuk Üniversitesi Ahmet Kelesoğlu Egitim Fakültesi Dergisi*, 30, 361-377.

Yılmaz, C., Altun, S. A. & Olkun, S. (2010). Factors affecting students' attitude towards Math: ABC theory and its reflection on practice. *Procedia Social and Behavioral Sciences,* 2, 4502–4506.

Yılmaz, S., Turgut, M., & Kabalcı, A. D. (2008). Ortaöğretim öğrencilerinin geometrik düşünme düzeylerinin incelenmesi: Buca ve Erdek örneği. *Üniversite ve Toplum*, 8(1). Retrieved April 2, 2012 from http://www.universite-toplum.org/text.php3?id=354.

Yücel, Z. & Koç, M. (2011). The relationship between the prediction level of elementary school students' math achievement by their math attitudes and gender. *Elementary Education Online*, 10(1), 133-143.