INVESTIGATING HIGH SCHOOL STUDENTS' ATTITUDES TOWARDS GEOMETRY ACCORDING TO DIFFERENT VARIABLES: SAMPLE OF ORDU CITY

Lise Öğrencilerinin Geometriye Karşı Tutumlarının Çeşitli Değişkenlere Göre İncelenmesi: Ordu İli Örneği

Meral CANSIZ AKTAŞ[1]
Devrim Yaşar AKTAŞ[2]

Abstract

The purpose of this study is to determine high school students' attitudes towards geometry with respect to various variables. The study was conducted by using survey method. In this study "Geometry Attitude Scale" developed by researchers was used. This scale, of which Cronbach α reliability coefficient was calculated as 0,89, was administered to 536 high school students in Ordu. The data was analyzed through calculating standard deviation, mean value as well as independent sample t-test and one way Anova for group comparisons. At the end of the study it was determined that there was a significant difference according to kind of school and students' branches. On the other hand, there was no significant difference according to gender and grade. It was recommended that future studies should focus on investigating attitudes towards geometry by choosing bigger sample from different cities of Turkey and the effects of new geometry curriculum on the students' attitudes towards geometry.
Key Words: Attitude, attitude towards geometry, new geometry curriculum

Özet

Bu çalışmanın amacı, lise öğrencilerinin geometriye karşı tutumlarını çeşitli değişkenlere göre belirlemektir. Araştırma tarama metodu kullanılarak yürütülmüştür. Çalışmada araştırmacılar tarafında geliştirilmiş olan "Geometri tutum ölçeği" kullanılmıştır. Cronbach α güvenirlik katsayısı 0,89 olarak hesaplanan bu ölçek, Ordu ilinde 536 lise öğrencisine uygulanmıştır. Veriler standart sapma, ortalama hesabının yanında bağımsız gruplar t-testi ve tek yönlü Anova kullanılarak analiz edilmiştir. Çalışmanın sonucunda okul tipine ve öğrencilerin öğrenim gördükleri bölümlere göre tutumlarda anlamlı farklılık olduğu; cinsiyet ve sınıf düzeyine göre tutumlarda anlamlı bir farklılık olmadığı bulunmuştur. Yapılacak çalışmalar için farklı illerden seçilecek daha büyük bir örneklem üzerinde çalışılması ve yeni geometri programının öğrenci tutumları üzerindeki etkisinin araştırılması önerilmiştir.
Anahtar Kelimeler: Tutum, geometriye karşı tutum, yeni geometri programı

INTRODUCTION

Geometry, the study of space and spatial relationships, is an important and essential branch of mathematics. Through the study of geometry, students

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[1] Yrd.Doç.Dr.; Ordu Üniversitesi, Fen Edebiyat Fakültesi, Matematik Bölümü, Ordu, cansizmeral@hotmail.com
[2] OMÜ Eğitim Bilimleri Enstitüsü İlköğretim Bölümü Doktora Öğrencisi

will learn about geometric shapes and structures and understand how to analyze their characteristics and relationships (National Council for Teachers of Mathematics, 2000).

In Turkey while geometry is taught as a topic within mathematics in elemantary education, it is a subject independent from mathematics in secondary schools. According to Baykul (2005) geometry has taken place in curriculums since elemantary education because of contributing development of students' critical thinking and problem solving activities, being an important area of mathematics that is used in daily life, helping students to realize the world around themselves and appreciate the worth of their world. He also stated that geometric concepts are contributing to learning concepts in other areas of mathematics. Similary according to Suydam (1985), by studying geometry students have spatial intuition about the real world, gain knowledge needed to study more mathematics and skills in the reading and and interpretation of mathematical arguments (as cited in Aydoğan, 2007). But the results of numerous studies show that students encounter a lot of difficulities while learning geometry (Ubuz and Üstün, 2003; Üstün, 2003). This argument is consistent with the results of international studies such as The Third International Mathematics and Science Study (TIMSS) and The Programme for International Student Assessment (PISA). In both mentioned studies, Turkey is one of the most unsuccesful countries, especially in geometry. For example in TIMSS (1999, as cited in Mullis et.al., 2000), the Turkish students got the lowest mean scores in the part consisted of geomety questions and of the 38 participating counties, Turkey was fifth from the end. On the other hand, attitudes play an important role on students' achievement (Aşkar, 1986; Davis, 2002, cited from Duatepe and Ubuz, 2007; Özyürek, 1983, cited from Göç, 2010; Hammouri, 2004; Işık and Çağdaşer, 2009; Ma and Xu, 2004; Moenikia and Zahed-Babelen, 2010; Mriano, 2005; National Council for Teachers of Mathematics, 2000; Papanastasiou, 2000; Papanastasiou, 2002; Peker and Mirasyedioğlu, 2003; Savaş, Taş and Duru, 2010; Tağ, 2000; Webster and Fisher, 2000; Wilkins and Ma, 2003; Yıldız, 2006). So students' attitudes towards the subject beeing studied and the factors effect them must be known to take necessary precautions.

Many studies have been carried out on the attitudes towards mathematics with respect to some variables. Most of the studies were primarily on the correlation between attitude and achievement and in these studies it was found that there was a meaningful correlation between attitude towards mathematics and education. On the other hand in some studies it was searched whether there was a change in the attitude towards mathematics while the grade levels change or not. While some of these studies (Akın, 2002; Baykul, 1990; Özgün-Koca and Şen, 2006; Taşdemir, 2009; Ünlü 2007) revealed that the negative attitude towards mathematics increased when the grade levels increased, some of them (Yenilmez and Özabacı, 2003) states that there was no change or there was a change it has no practical meaning. In some studies (Tapia and Marsh, 2000; Yetim, 2006) while gender was

presented as a factor affecting the attitude towards mathematics and in some studies (Akın, 2002; Akdemir, 2006; Aksu, Demir and Hatipoğlu, 2002; Çelik and Bindak, 2005; Demir, 2004; Duman, 2006; Dursun and Dede, 2004; Gülten et. al. 2011; Köğce et. al., 2009; Uluat, Kara & Bilgin, 2002; Ursini and Sanchez, 2008; Yenilmez and Özabacı, 2003; Yıldız, 2006; Yücel and Koç, 2011) it wasn't.

Although considerable research has beeen conducted on the beliefs and attitudes towards mathematics, relatively less research has been done on these topics towards geometry. And while there is a large literature on attitudes, their development and measurement, there is a lack of detailed attitude measurement with students examining effects of new mathematics and geometry curriculums, which has been implementing in Turkey since 2005 and 2009 respectively on students' attitudes towards mathematics and geometry. In this context this study will contribute to fill in the gap in this area. And also it will enable to give some clues about the effects of new geometry curriculum on the students'attitudes towards geometry when the data examined at two levels (9th and 10th) of high school.

The purpose of the study

The purpose of this study is to determine high school students' attitudes towards geometry with respect to various variables (their gender, type of school, grade and branch).

Research problem

The research problem of this study is ''What is the status of the high school students' attitudes towward geometry? To illuminate this issue answers of following sub-problems were looked for:
1. What is the profile of the high school students' attitudes towards geometry?
2. Is there a significant difference between high school students' towards geometry and their gender, type of school, grade and branch?

METHOD

Research Design

The research is a study of survey model. The scale which was used in this study included a section assessing the independent variables; gender, type of school, grade, branch.

Participants

The sample consisted of total 536 high school students randomly selected from different kind of schools in Ordu.

Tablo 1. *The profiles of the participants*

Gender	f	%
Female	248	46,3
Male	288	53,7
Type of School		
Public High School	126	23,5
Anatolian High School	202	37,7
Anatolian Teachers' High School	100	18,7
Vocational High School	75	14
Private High School	33	6,2
Grade		
9th grade	148	27,6
10th grade	117	21
11th grade	148	27,6
12th grade	123	22,9
Branch		
Science	173	32,3
Turkish-Mathematics(TM)	215	40,1
No branch (9th grade)	148	27,6
Total		100

As seen in Table 1, 46,3% of the participants are female while the rest, 53,7% are male. In terms of school type, the distribution is that 23,5% of the participants are at Public High School, 37,7% of the participants are at Anatolian High School, 18,7% of the participants are at Anatolian Teachers' High School, 14% of the participants are at Vocational High School and 6,2% of the participants are at Private High School. Besides 27,6% of the participants are at the 9th grade, 21% are at 10th grade, 27,6 % are at 11th grade and 22,9% are at 12th grade. And finally, 40,1% of the participants are at TM branch, 32,3% of the participants are at Science branch and 27,6% of the participants haven't got any branch.

Data Collection
While the measurement of attitudes towards mathematics can be examined by using direct observation, interviews, questionnaries and student drawings or writings, Aiken (1985: as cited in Utley, 2007) pointed out that attitude scales were the most popular, objective an efficient in the data collection process.

In this study "Geometry Attitude Scale" developed by researchers was used as data collection instrument. The draft scale which consisted of 40 items was administered to 639 high school students at 5 different typed high school in Ordu. As a result of item analysis (item analysis according to differences between mean scores of upper and lower groups and item analysis

according to correlation) and factor analysis procedures, the geometry scale grouped into four factors accounted for 47,03% of total variance with 24 items and Cronbach- Alpha, total internal reliability coefficient, of the final scale was calculated as 0,89.

In the first section of this scale a section was constructed consisted of four close-ended question in order to collect data about participants' demograghic variables. In these items high school students were asked to give information about their gender, type of school, grade, branch, the grade in geometry and mathematics lesson in the last school term. On the other hand the final attitude scale consisted of 24 items was employed to determine student' attitudes towards geometry. While the lowest point to be taken was 24 and the highest was 120. The lower points indicate negative attitudes towards geometry and the higher points indicate the positive attitudes. In this study, the reliability coefficient was calculated as 0,89 too.

Data Analysis

In this process positive items in the geometry scale were assigned with numerical values ranging from 1 = "Strongly disagree", to 5 = "Strongly agree". For negative statements the scoring was reversed. As appropriate for 5 point Likert scale at data collection instruments while scoring and interpreting the findings, the score intervals are respectively 24-43.19 for "very low", 43.2-62.39 for "low", 62.4-81.59 for "mid level", 81.6-100.79 for "high" and 100.8-120 for "very high".

While analyzing data, descriptive statistics such as frequency, mean and percentage were used. Furthermore independent sample t- test was carried out for comparisons two groups an one-way ANOVA was carried out for comparisons of groups more than two. In order to investigate which group caused the difference in the group comparison, Schefe test was used.

FINDINGS

Firstly, mean and standat devaition were calculated for obtaind data to determine the distribution of high school students' attitudes towards geometry,

Tablo 2. *Distribution of high school sudents' attitudes towards geometry*

	N	Minimum	Maximum	Mean	Std. Deviation
Attitudes Towards Geometry	536	24	119	75,40	19,67

The mean value score for high school students' attitudes towards geometry was found as 75,40 standard deviation as 19.67, the maximum score as 119 and the minimum score as 24. Based on these findings, it could be claimed that the high school students' who participate in this study have "mid level" attitudes towards geometry.

An independent sample t-test was applied to determine whether there is a gender based difference on attitude towards geometry. The results of the test are presented in Table 3.

Tablo 3. *Independent sample t-test results according to gender*

Gender	N	Mean	SD	df	t	p
Female	248	75,81	19,87	534	,446	,656
Male	288	75,05	19,52			

As it seen in Table 2, the male and female high school students' average attitude scores towards geometry were 75,05 and 75,81 respectively. This means that there is no significant difference between students' attitudes towards geometry according to gender [$t_{(534)}$ = ,446, p>.05].

A one-way Anova was performed high school students' attitude scores towards geometry in order to see whether their attitudes towards geometry changed according to school type and then Scheffe test was used to determine of which group caused the difference in the group comparison. The results obtained in this process are presented in Table 4 and Table 5.

Tablo 4. *Descriptive Statistics According to School Types*

School type	N	Mean	SD
Public High School	126	72,40	19,67
Anatolian High School	202	77,49	20,53
Anatolian Teachers' High School	100	78,75	16,52
Vocational High School	75	69,19	18,57
Private High School	33	78,01	20,31

Tablo 5. *Anova Results According to School Type*

School Type	Sum of Squares	df	Mean Square	F	p	Difference
Between	6254,331	4	1563,583	4,136	,003	Anatolian - Vocational
Within Groups	200764,195	531	378,087			
Total	207018,526	535				Anatolian Teachers'-Vocational

When Table 4 and Table 5 are examined, it could be seen that the high school students' attitude scores towars geometry differ in terms of school type. Among the group, the students who study at Anatolian Teachers' High School have the highest mean value (78,75), whereas the students who study at Meslek Liseleri have the lowest mean value (69,19). It means that a significant

difference was found in terms of the school type. [$F_{(4-531)}$ = 4,136, p<.05]. Additionally Scheffe test showed that there was a significant difference between Anatolian High School students and Vocational High School students in favor of Anatolian High School students. There was also significant difference between Anatolian Teachers' High School students and Vocational High School students in favor of Anatolian Teachers' High School students.

In order to see whether students' attitudes towards geometry varied in accordance with the grade, a one-way between-groups ANOVA test was used. The results obtained in this process are presented in Table 6 and Table 7.

Tablo 6. *Descriptive Statistics According to Grade*

Grade	N	Mean	SD
9th	148	77,12	18,31
10th	117	76,03	19,39
11th	148	73,13	21,31
12th	123	75,47	19,42

Tablo 7. *Anova Results According to Grade*

School Type	Sum of Squares	df	Mean Square	F	p
Between Groups	1244,204	3	414,735		
Within Groups	205774,322	532	386,794	1,072	,360
Total	207018,526	535			

When Table 6 and Table 7 are examined, it could be seen that there wasn't a significant difference in terms of students' grade [$F_{(3-532)}$ = 1,072, p>.05].

An independent sample t-test was applied to determine whether there is a significant difference considering branches because there is no other branch (like social or language branches) except science and TM for the sample of this study. The results of the test are presented in Table 8.

Tablo 8. *Independent sample t-test results according to branches*

Branch	N	Mean	SD	df	t	p
Science	173	78,08	19,26	386	-2,952	,003
Turkish-Mathematics	215	72,07	20,48			

As it seen in Table 8, high school students' average attitude scores in the science and TM branches towards geometry were 78,08 and 72,07 respectively. According to Table 8 it can be understood that there was a significant difference between students' attitudes towards geometry according to branches[$t_{(386)}$ = -2,952, p<.05].

DISCUSSION, RESULTS AND RECOMMENDATIONS

When the literature examined, it was seen the number of researches which were carried out to determine students' attitudes towards geometry (Bindak, 2004; Özkeleş-Çağlayan, 2010) were limited and researches on attitudes towards mathematics (Akın, 2002; Akdemir, 2006; Aksu, Demir and Hatipoğlu, 2002; Çelik and Bindak, 2005; Demir, 2004; Duman, 2006; Dursun and Dede, 2004; Gülten et. al., 2011; Kanbolat et. al., 2011; Köğce et. al., 2009; Tapia and Marsh, 2000; Uluat, Kara and Bilgin, 2002; Ursini and Sanchez, 2008; Yenilmez and Özabacı, 2003; Yetim, 2006; Yıldız, 2006; Yücel and Koç, 2011) were more common. So in this section the results obtained in this study concerning attitudes towards geometry presented by using the results of studies which were conducted on attitudes towards mathematics when necessary. This is made with the thought that geometry is an important part of mathematics.

Researches which focused on attitudes towards mathematics have reported significant differences in male and female attitudes. In this study according to the score averages of high school students' attitudes towards geometry, it was seen that female students had more positive attitudes towards geometry than male students but this difference of attitude scores among genders was found statistically insignificant. It was determined in similar studies that attitudes towards mathematics didn't change according to gender (Akdemir, 2006; Akın, 2002; Aksu, Demir and Hatipoğlu, 2002; Çelik and Bindak, 2005; Demir, 2004; Duman, 2006; Dursun and Dede, 2004; Gülten vd. 2011; Köğce et. al., 2009; Uluat, Kara and Bilgin, 2002; Ursini and Sanchez, 2008; Yenilmez and Özabacı, 2003; Yıldız, 2006; Yücel and Koç, 2011). The results of these studies support the results obtained from this study. On the other hand, there are some studies which found a meaningful difference between the gender and attitudes towards mathematics (Demirgören, 2010; Şentürk, 2010; Tapia and Marsh, 2000; Uysal, 2007; Yetim, 2006; Yetişir, 2007). So when the researches conducted on the relation between gender and attitudes towards mathematics examined, it can be understood that there isn't a clear conclusion. So it can be said that the factors which constitute attitudes towards mathematics have the same effect on female and male students. According to Yücel and Koç (2011), irrespective of gender, all of the students have similar method of approach to mathematics because of being a basic lesson which all students encounter during their education and being an important part in exams which are used to determine students' success.

Our study made clear that the variable "kind of school (Public High School, Anatolian High School, Anatolian Teachers' High School, Vocational High School)" influences students' beliefs and attitudes. According to obtained data, it was understood that students from Anatolian High Schools and Anatolian Teachers High School have more positive attitudes towards geometry than students from Vocational High Schools and this difference is

statistically significant. This finding is in accordance with the findings revealed in many studies (Akdemir, 2006; Yıldız, 2006). For example Yıldız (2006) concluded that there was a significant difference between students' attitudes towards mathematics from Super High School (a kind of school which was removed since 2005-2006 academic year) and Public High Schools and also Vocational High Schools in favor of Super High School. In fact this conclusion verified the claim emphasising the positive correlation between attitude and achievement which we mentioned above. Because in Turkey some high schools like Anatolian High schools, Anatolian Teachers High Schools and Science Schools choose their students with an entrance examination. Needless to say that only successful students study at in these schools. As regard as Super High Schools which we encountered in the past, they took into account students' academic achievement when they were choosing their students. Hayduk (1987) defined the relation between attitude towards mathematics and mathematical achievement as a circle (as cited in Duman, 2006). From this point it is thought that the results we obtained in this study become more significant. Similary Akdemir (2006) argued that there was a significant difference between students' attitudes towards mathematics with regard to school type and students from Private School had more posititive attitudes than students from Public High School.

The third finding of this study showed that there wasn't a significant difference in the high school students' attitudes towards geometry in terms of their grade. But when the obtained data examined it was seen that students who were at 9th and 10th grade have more positive towards geometry than students at 11th and 12th grade. The statement "to be able to develop positive attitude towards geometry" is among the purposes of new geometry curriculum. So it was thought to result from the new geometry curriculum that has been implementing since 2009-2010 academic year. This finding overlapped with some researches (Demirgören, 2010; Kanbolat et. al., 2011; Taşdemir, 2009) in which attitudes towards mathematics examined according to variable "grade" .

The last finding of this study revealed that there was a siginificant difference in the high school students' attitudes towards geometry in terms of their branch in favor of science branch. This result show a consistency with results of the study of Yıldız (2006) implicating that there was meaningful difference between branches and attitudes towards mathematics. Yıldız (2006) argued that there were significiant differences in the students' attitudes towards mathematics among Science and Social branches, Science and Turkish-Mathematics Branches and Turkish-Mathematics and Social branches. This result may be explained the fact that who choose science branch are usually more hardworking in geometry and use geometry in their different lessons like physics. On the other hand Uluat, Kara and Bilgin (2002) found that the students whose branches were science and mathematics had more positive attitudes towards mathematics than students whose branches were social. In this study there was no student whose branch was social. Because in

social branches, geometry lesson is not compulsory. So in the sample selection process these students removed. Needless to say that the finding of this study shows consistency with the studies showing the relation between achievement and positive attitudes towards a lesson.

The data used in this study were collected from different typed high schools in Ordu. It is recommended thar similar studies can be conducted with a big sample chosen from different cities. The study can be strengthened by examining attitudes towards geometry in terms of different variables. When the literature examined, it was understood that there wasn't enough study on attitudes towards geometry. So the numbers of studies on this topic must be increased. On the other hand studies dealing with the effects of new geometry curriculum on students' attitudes towards geometry should be conducted.

Being aware of the students' attitudes towards geometry will be useful for teachers. At the beginning of each semester, the attitude scale which was used in this study or another one might be applied to the students, so that teachers would identify the students who have negative attitudes towards geometry and would take required precautions. As we mentioned above in new geometry curriculum there is no suggested geometry attitude scale for teachers to use in their applications. So researches dealing with this case should be conducted

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