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STUDENTS' ATTITUDES TOWARDS MATHEMATICS AND THE IMPACTS OF MATHEMATICS TEACHERS' APPROACHES ON IT

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Abstract. The purpose of the study is to determine students' attitudes towards mathematics, to investigate these attitudes according to the different variables, and to reveal the impacts of mathematics teachers' approaches and in–class activities on the students' attitudes towards mathematics. The study was conducted with the high school students from Turkey. This study was a mixed of the quantitative and qualitative methods. The data obtained from the scales named Mathematics Attitude Scale (MAS) and Mathematics Teachers' Approaches Questionnaire (MTAQ) and the semi–structured interviews. The MAS was used to determine the students'attitudes towards mathematics and the MTAQ was used to assign mathematics teachers' activities and approaches in their lessons. The application of the scales conducted with the 450 students (253 female and 197 male) and the interviews were carried out with the 25 students chosen from the samples. The quantitative data were analyzed by using the statistical software and the qualitative data were analyzed by using the content analysis. The study showed that the students' attitudes towards mathematics differed by, gender, field, and mathematics score but not by grade and that the teachers' approaches and activities impacted the students' attitudes towards mathematics in some aspects.

Key words: Attitudes towards mathematics, high school students, mathematics teachers' approaches.

1. Introduction

Attitudes are defined approaches as an organization of several beliefs focused on a specific object or situation tendency one to respond in some preferential manner (Rokeach, 1972 as cited in Martino and Zan, 2001). According to Allport (1935), the attitude is a psychological or mental preparation status that is formed as a result of experiences, that has a leading or dynamic influence on a person's behaviors towards all objects or situations in which he or she has been involved (Freedman, Sears and Carlsmith, 1989). Mc Leod (1992) stated that, attitude was composed of the constructs named the affective domain, the beliefs and the emotions. Attitudes are intensive feelings, relatively stable, which are consequence of positive or negative experiences over time in learning a topic. Thurston (1929) also defined the attitude as a combination of tendencies, human emotions, fears, beliefs as to a distinct problem and prejudices (Utsumi and Mendes, 2000). To Brito (1996), an attitude is a tendency present in a person and directed to objects, events or human beings in the light of his or her experiences (Utsumi and Mendes, 2000). In additionally, Özlü (2001) stated that an attitude was constructed the consequence of person according to his/her past experiences and it is a behavior preparatory tendency rather than an observed comportment (Özlü, 2001). As it is seen, there are myriad numbers of definitions about attitude. The common point of almost all of them is that an attitude is a tendency preparing a person to behave and it has some perceptive, cognitive and behavioral component in this tendency. Neale (1969) defined the attitude towards mathematics as a person's tendency to like or to hate mathematics, to deal with or to avoid from mathematical activities, his or her belief of being successful or not in mathematics or a belief that mathematics was useful or not (Maqsud, 1998).

Among the reasons for being unsuccessful in mathematics, students' negative attitudes towards mathematics take the important part. Many researchers contend that attitudes were important factors that could influence a student's achievement (Lester, Garofalo and Kroll, 1989; Meyer and Koehler, 1990; Papanastasiou and Papanastasiou, 2002; Shaughnessy, Haladyna and Shaughness, 1983 as cited in Papanastasiou and Papanastasiou, 2005). However, many students thought that mathematics was a

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difficult subject and they concerned that they could not be successful in mathematics, which affects the attitudes towards mathematics in a negative way (Alkan, Bukova–Güzel, and Elçi, 2004). Unfortunately, this opinion continues during school years. As a result, some students have negative attitudes towards mathematics and thus they may lose their self–confidences on mathematics. Moreover, these persons may begin to think that they are not clever enough to learn mathematics and may not regard mathematics in their areas of interest. It depends on many factors but, mathematics teachers' instructional approaches, roles, teaching methods, and their attitudes towards mathematics take an important role in this misunderstanding.

There have been many researches examining the impacts of gender, achievement, socio–economic status and teachers' attitudes on students' attitudes towards mathematics. According to George (2000), teachers played a primary role in their student's learning process. Haladyna and Shaughnessy (1983) have showed that teacher and the variables of learning environment were important because they had the greatest influence on students' attitudes and they were easily manipulated to bring about changes in attitudes (as cited in George, 2000).

There have been some investigations assessing the relationship between the attitudes towards mathematics and the approaches of teacher. Students adopt many attitudes of their teachers because they take them as models. The attitude towards mathematics has been known to be affected by the relationship between the teacher and student (Peterson and Fennema, 1985). Researchers showed that teachers' attitudes towards mathematics can in some way influence their students' attitudes and mathematical learning (Relich and Way, 1994 as cited in Amato 2004). Besides, it was proved that there was a parallel relationship among teachers' attitudes towards mathematics and mathematics teaching, and their students towards mathematics (Carter and Norwood, 1997). Therefore, many educators thought that developing positive attitudes towards mathematics would be an important aim in the education of primary school student teachers (Relich and Way, 1994; Haylock, 1995 as cited in Amato, 2004). This thought is also valid for the other disciplines' student teachers.

In this direction, the purpose of this study is to determine students' attitudes towards mathematics, to investigate these attitudes according to the different variables and to reveal the impacts of mathematics teachers' approaches and in–class activities on their students' attitudes towards mathematics. For this purpose, the following research questions were determined:

1) Students' attitudes towards mathematics differ by gender?
2) Students' attitudes towards mathematics differ by their grades?
3) Students' attitudes towards mathematics differ by their fields of study?
4) Students' attitudes towards mathematics differ by average of mathematics scores?
5) How the students evaluate their teachers' approaches and activites in mathematics lesson?
6) Which categories are revealed about their mathematics teachers' characteristics impacting the students' attitudes towards mathematics?

2. Method

This study was a mixed of quantitative methods and qualitative methods. The quantitative data were collected by means of scales and the qualitative data were collected by interviews.

2.1. Samples. The sample of this study included 450 students (253 female and 197 male students) who were 9th, 10th, 11th and 12th grade students in high schools in Turkey. The sample was categorized in three groups by their grades (137 students in 9th Grade, 150 students in 10th Grade, 24 students in 11th Grade, and 139 students in 12th Grade). The students' fields of study were categorized in three groups as Science–Mathematics Oriented (SMO) including intensive mathematics and science lessons, Turkish–Mathematics Oriented (TMO) including intensive mathematics but no science, and Others including rare mathematics. 360 students were in SMO, 72 students were in TMO and 18 students were in others. The students were also categorized by average mathematics scores: 36 students in Score 1 (point between 0–49), 44 students in Score 2 (point between 50–54), 111 students

in Score 3 (point between 55–69), 154 students in Score 4 (point between 70–84), and 105 students in Score 5 (point between 85–100).

Instruments. In this study, the data were obtained from the Mathematics Attitude Scale (MAS) and Mathematics Teachers' Approaches Questionnaire (MTAQ) and the semi–structured interviews. These scales were 5–point Likert–type scale developed by Alkan, Bukova Güzel and Elçi (2004). The MAS was used to determine the students' attitudes towards mathematics and the MTAQ was utilized for identifying mathematics teachers' approaches in class activities. The MAS consists of 42 items and MTAQ consists of 20 items.

The qualitative data were obtained using the semi–structured interviews. The interviews were carried out with the 25 students from the samples. The interview form contained ten questions that were compatible with MTAQ items. The purpose of the interview was to determine the students' views concerning their mathematics teachers' in–class activities, approaches which the student's attitudes towards mathematics were affected. It was thought that the 25 students chosen to be interviewed reflected their real opinion.

Analysis. Descriptive statistics of the students' attitudes towards mathematics were presented as mean and standard deviation (SD) by gender, grade, field, and score categories. Males and Females were compared using t–test. Students' attitudes towards mathematics were compared by grade, field, and mathematics score categories using one–way analysis of variance (ANOVA) test. If the result from ANOVA was statistically significant, multiple pairwise comparisons using Sidák adjustment method following the ANOVA were performed to examine the differences among the subgroups. P values from these tests were reported. The significance level for two–sided hypothesis testing was set at 0.05.

The interview data were analyzed both the researcher and another mathematics educator, then encoded and reliability percent was obtained by comparing and contrasting the coding. While analyzing data, they revised the categories proposed by Alkan, Bukova–Güzel, and Elçi (2004).The differences were determined and the final version of the code list was constructed. As a result of the coding process, the inter–coder reliability was determined by using the formula of Miles and Huberman (1994) and the reliability for interview data was determined as 93%. As a result of the analysis of interview, the seven categories were constituted. These categories were:

i) cognitive–based approaches
ii) tools and materials for teaching
iii) assessment approaches
iv) instructional methods and techniques
v) being open to innovations
vi) classroom management
vii) affective–based approaches

2.2. Findings

Students' attitudes towards mathematics were compared between females and males. Results from the t–test revealed that there was a statistically significant difference between females and males (t value=4.16, P<0.001). Table 1 shows that students' attitudes towards mathematics score was statistically higher for females compared to males.

Table 1. *Attitudes towards mathematics by gender*

Gender	N	Mean ± SD	t value	P value	Interpretation
Female	253	149.57 ± 25.30	4.16	<0.001	Significant
Male	197	138.96 ± 28.72			

SD, Standard Deviation. Data are presented as number of students (n) and Mean ± SD. t value and p-value are reported from *t*-test comparing the attitudes towards mathematics between Female and Male

Results from the ANOVA showed that students' attitudes towards mathematics was not statistically significant among the grades (F value=2.56, P=0.055). Table 2 presents the results comparing the students' attitudes towards mathmetics by grade. Students' atitudes towards mathematics was higher for Grade 11 compared to the other grades.

Table 2. *Students' attitudes towards mathematics by grade*

Grade	n	Mean ± SD	F value	P value	Interpretation
Grade 9	137	145.61 ± 26.82	2.56	0.055	Not significant
Grade 10	150	141.20 ± 27.23			
Grade 11	24	156.63 ± 28.57			
Grade 12	139	146.25 ± 27.27			
Total	450	144.92 ± 27.33			

SD, Standard Deviation. Data are presented as number of students (n) and Mean ± SD.
F value and p-value are reported from the ANOVA test comparing the attitudes towards mathematics among the four grades.

Table 3 describes the students' attitudes towards mathematics by field. There was a statistically significant difference in the students' attitudes towards mathematics among the three fileds (F value=29.30, P<0.001). Sidák multiple adjustment test following ANOVA showed that there were statistically significant differences between Science–Math and Turkish–Math (P<0.001) and between Science–Math and Other (P=0.004). There was no statistically significant difference between Turkish–Math and Other (P=0.915). Science–Math had more positive attitudes than Turkish–Math and Other.

Table 3. *Students' attitudes towards mathematics by field*

Field	n	Mean ± SD	F value	P value	Interpretation
Science–Math	360	149.56 ± 25.39	29.30	<0.001	Significant
Turkish–Math	72	125.60 ± 27.72			
Other	18	129.56 ± 24.84			
Total	450	144.92 ± 27.33			

SD, Standard Deviation. Data are presented as number of students (n) and Mean ± SD.
F value and p-value are reported from the ANOVA test comparing the attitudes towards mathematics among the three fields.

Table 4 presents the students' attitudes towards mathematics by five mathematics score categories. Results from the one-way ANOVA showed that there was a statistically significant difference in students' attitudes towards mathematics among the five score categories (F value=27.61, P<0. 001). Sidák multiple adjustment test following ANOVA showed that students whose score is between 85–100 had more positive attitudes compared those who are in the other four score categories (P<0.001). Score 70–84 had statistically more positive compared to Score 50-54 (P=0.003) and Score 0–49 (P<0.001) but not Score 55-69 (P=0.350). Score 0–49 had less positive compared to Score 50–54 (P=0.029) and score 55–69 (P<0.001). Score 55–69 had more positive than Score 50–54 but this different was not statistically significant (P=0.306).

Table 4. *Students' attitudes towards mathematics by mathemtatics score*

Score category	n	Mean ± SD	F value	P value	Interpretation
0–49	36	115.53 ± 27.96	27.61	<0.001	Significant
50–54	44	132.02 ± 26.94			
55–69	111	141.23 ± 25.06			
70–84	154	147.47 ± 23.16			
85–100	105	160.58 ± 23.81			
Total	450	144.92 ± 27.33			

SD, Standard Deviation. Data are presented as number of students (n) and Mean ± SD.
F value and p-value are reported from the ANOVA test comparing the attitudes towards mathematics among the average of mathematics score categories.

The students' attitudes towards mathematics gained from MAS and the ones they took from MTAQ were examined whether there was a statistically significant correlation between them. It was observed that the statistically significant relationship was quite powerful (see Table 5).

Table 5. *The Pearson correlation analysis results aiming at determining the relationship between students' MAS and MTAQ points*

	MAS Points
MTAQ Points	**r = 0,782**
	Powerful relationship in a positive way

As a result of the data obtained through MTAQ, some of the in–class approaches and activites of mathematics teachers were sampled in Table 6 with their average percentages. These percentages indicated the teacher's approaches and in–class actitives from the point of view of the students.

Table 6. *Mathematics teachers' approaches and in-class actitives impacting attitudes towards mathematics*

MTAQ results	***Percentages***
He/She gives examples for the subjects to be comprehended better	84%
He/She encourages students about doing mathematical investigations	79%
He/She organizes the appropriate learning environment	62%
He/She asks students make predictions in problem solving	62%
He/She relates a mathematical concepts	60%
He/She is interested in the students' mathematical improvement	61%
He/She believes that the students will be successful in mathematics	58%
He/She provides the active participation of the student in lesson	52%
He/She relates mathematical subjects and concepts in with the real world	45%
He/She uses instructional tools than the board and chalks	39%
He/She presents different learning approaches during the lesson	32%
He/She utilizes different problem solving approaches	29%
He/She acts neutral towards students	25%
He/She hurshly criticizes when students make mathematical mistakes	21%

For the answers given to the questionnaire to be supported, to be more valid, to be explained and to find out more information on these subjects, the interviews with the selected samples were analyzed. The teachers' approaches and activites impacting the students' attitudes towards mathematics were collected under the seven main categories (see Table 7).

Table 7. *The mathematics teachers' approaches and activities impacting attitudes towards mathematics*

Cognitive–Based Approaches	to know basic mathematical concepts, axioms, principles and generalizations to associate mathematical concepts with the others to relate mathematical concepts with real world to give examples that can make the object to be concerned better to present different approaches in mathematical problem solving
Tools and Materials for Teaching	to use computer and projector to use overhead to use ruler, protractor and similar hand devices to use the board or the projector systematically correct

	to use different source books
Assessment Approaches	to use closed answer based questions and answers obtained on formulas to consider different solution approaches about questions to use different assessment tools to consider problem solving process rather than the result of the problem not to be faire among students
Instructional methods and techniques	to use a different techniques in the formation of concept to perform activities that with draw the attention of the student to present approaches that will keep the student away from boredom to motivate the student by using some different competions and similar activities to provide the active participation of the students to have the habit of studying together
Being Open to Innovations	to participate in different activities to renew herself to use the new teaching sources to develop use of technology
Classroom Management	to make the students active in class, to present tolerant behaviors to carry out a healthy communication between the students and her field to use gestures, mimics, and body language efficiently
Affective–Based Approaches	to present patient behavior towards students' mistakes to love mathematics to feel happiness from the students' learning mathematics to be excited and willing during the lesson

The interview results showed some approaches and activities of mathematics teachers were important while shaping students' attitudes towards mathematics. The mathematics teachers' cognitive based approaches were one of them. In this category, the students emphasized the teachers' content knowledge such as use of examples, representing mathematical knowledge in different way, using problem solving and multiple solution, etc. 88% students stated that the mathematical concepts were not related to the real world. They 36% indicated that the relationship among mathematical concepts were not established exactly. Because of this they thought mathematics as combining discrete concepts and formulas. 24% of students stated that their mathematics teachers had difficulties in representing main theorem, axioms and generalizations about mathematics. When they (60%) did not understand some parts of the mathematical concepts, the mathematics teachers gave different examples. So they could better understand and in this direction they stated that they more liked mathematics. On the other hand the students impressed somer teachers' approaches affected them in a negative way such as teachers said "It was given as such in text books", "You can find out if you examine your textbook".

In the category, tools and materials for teaching, the students expressed that they liked some material such as overhead, protractor, triangle, ruler, and etc. Only one student stated that his/her mathematics teachers used computer, techonological tools, animation, software and it was important for improving positive point of view about mathematics. 96% of the students indicated that their mathemics teacher used textbooks and especially they used various multiple–choice tests. 64% of the students expressed when they used tools such as ruler, protractor and similar hand devices they liked more these lessons.

In the assessment approaches category the students mainly expressed their teachers' questions used in both lessons and exams. The usage of questions which answers obtained from only formulas did not provide them (72%) think concepts in a deep way. However 32% of the students stated that when the mathematics teachers asked them find multiple solutions about questions the students thought deeply and in this situation they more liked mathematics 12% of the students stated that sometimes the mathematics teachers were faire among students and this affected them in a negative ways.

In the category named instructional methods and techniques, they generally mentioned teachers' teaching methods and instructional practices. Most of the students (92%) pointed out that teachers

should provide active participation of the students to the lesson. 78% of the students mentioned that teachers should use different techniques in the formation of concept. A small number of the students (16%) stated that when teachers used different competions and similar activities it motivated them.

The category named being open to innovations contained three subcategories about teachers' activities which improve themselves. The students (68%) stated that when the teachers' innovative approaches were performed in lessons such as a new technology, techniques, etc., they liked mathematics much.

The category named classroom management was handled under three subcategories. The students (72%) stated that teachers make the students active in class. Teachers' communications with their students were also seen important according to the participants. The students noticed that they wanted that their mathematics teacher should communicate with them person–to–person and behave tolerantly to mistakes and correct their mistakes, criticize in a positive way. Thus students thought that they could personally deal with mathematics easily and produce something. 40% of the students stated that a mathematics teacher should use gestures, mimics and body language in class.

The last category named the affective–based approaches contained four sub categories. They reflected that when their mathematics teachers loved mathematics; it affected their loving in a positive way (88%). To them, teacher was a model and students were affected by him/her. This qualification of a mathematics teacher was much more significant than his making the course enjoyable and interesting. 56% of the students highlighted that the mathematics teacher should be contended with teaching mathematics. 60% of the students stated that when mathematics teachers showed their negative opinions in teaching, it affected the students negatively and reduced their interest the lesson.

3. Conclusion, Discussion and Suggestions

This study revealed that there was a statistically significant difference between males and females students according to the attitudes towards mathematics. There was no statistically significant difference between the grades and the students' attitudes towards mathematics, the samples' attitudes towards mathematics and their fields of study, between MAS and MTAQ.

A statistically significant difference was found in favor of attitude female towards mathematics according to gender variable in the study conducted. This is consistent with studies that favor female in the attitude towards mathematics (Yenilmez, 2007; Özlü, 2001; Çelik and Bindak, 2005). There are also studies in which there is no meaningful difference between gender (Utsumi and Mendes, 2000; Avcı Coşkuntuncel and İnandı, 2011; Peterson and Fennema, 1985; Yaşar, Çermik and Güner, 2014 Akdemir, 2006) as well as studies in which the attitude toward mathematics is significantly different in favor of male (Brandell and Staberg, 2008; as cited in Owiti, 2011, Saracoğlu, 2016; Kaplan and Kaplan, 2006). As can be seen from the studies done, there is no common result between attitude toward mathematics and gender.

There was no statistically significant difference in attitude towards mathematics according to the grade level. It can be said that mathematics is an important lesson in our country, at every grade level, and at the university entrance examination. The causes can be investigated. In some studies (Kaplan and Kaplan, 2006), as the class level increased, the attitude score towards mathematics increased, while in some studies (Yenilmez and Özabacı, 2003) the attitude score decreased as the class level increased.

Students' attitudes towards mathematics according to the field they are studying have a positive attitude towards Science–Mathematics students compared to Turkish–Mathematics and other students. This result is consistent with the studies performed by Avcı, Coşkuntuncel and İnandı (2011) and Kaplan and Kaplan (2006). The decisive course of student selection in the field is mathematics. It can be said that Science–Mathematics students will be educated in a field related to mathematics in a higher education, and therefore they are more successful in mathematics and attitudes towards mathematics are more positive than others. On the other hand, some of the Turkish–Mathematics students choose this field because they will see mathematics in upper education, while others choose this field to escape from science courses. The majority of students in other areas choose these areas as an escape from mathematics and science courses, where it is necessary to make choices based on interest, desire and profession.

According to the mathematical scores, the students who score 85–100 in the attitudes towards mathematics show a positive attitude compared to the others. In some studies (Ma and Kishor, 1997; Minato and Kamada, 1996, as cited in Yaşar, Cermik and Güner, 2014), the students' attitudes towards mathematics have been found to increase as the attitudes towards mathematics increase. Kurbanoğlu and Takunyacı (2012) argues that students should develop positive attitudes towards mathematics in order to be successful in mathematics lessons.

The individual's attitudes towards mathematics presented alteration when subject to the influence of improvements apart from himself. Mathematics teachers' contribution to this alteration seemed to be quite high. Mathematics teachers were generally assessed the students by using evaluation tools formed of questions based on formulations and confusing functions. The students thought that these confusing formulations were the essence of mathematics and they could not improve their attitudes towards mathematics.

If the belief that mathematics was essential for a person all in his/her life time, there could be an improvement in the attitudes towards it. Firstly, mathematics teachers should believe that different approaches can exist in problem solving and later he/she should give worth to the students performing such approaches, however the opposite is the reality. The relationships among mathematical concepts can not be established correctly and there are difficulties in problem solving skills or to relate mathematical concept. Since such difficulties prevent an individual's mathematical thinking to improve, they decrease success.

In educating a mathematics teacher, teacher's contribution to learning in the classroom and her behaviors can be more positive if the acquaintance of mathematical power and thinking is taken to primary importance. A proper discussion environment can be formed among students and the duty of transfer turns out to be forming. As a result, class can be place more attractive and some contributions to improve the attitudes towards mathematics can be achieved in a positive way.

If it is tried and worked out, any student's attitudes towards mathematics can be elevated to an adequate level. Especially students in elementary schools should be better guided and their attitudes towards mathematics should be leveled up to the desired level. In this context, primary school teachers must take responsibility for developing positive attitudes to the mathematics. According to the researchers, to develop positive attitudes to mathematics in children, primary school teachers must learn how to set up learning experiences that are enjoyable, interesting and give the learner a sense of accomplishment. In order to be able to do this, the teachers must have had such experiences themselves (Weissglass, 1983 as cited in Amato, 2004).

There are some assignments for the teachers in order to improve students' attitudes towards mathematics in a positive way: (a) they should do activities and studies suitable to students' cognitive demand level, (b) homework open to research should be assigned rather than classical homeworks, (c) instead of memorizing, the student should be provided to achieve the conceptual formation, (d) the student should comprehend that a function can be done by more than one way, (e) there cannot be time–limits, mistakes should be tolerated, (f) mathematics should be altered and become funny, (g) students should be let to express their opinions, and (h) students should be provided to love mathematics by telling its necessity. The findings of this study indicated that further research would be carried out to determine the factors of impacting students' attitudes towards mathematics.

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