The Effect of Fast Draw Learning Strategy on the Academic Achievement and Attitudes Towards Mathematics

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Abstract

This study investigated the ways in which Fast Draw learning strategy affects the third grade students' academic achievement and attitudes toward mathematics in the mathematics course. The study used one of the semi-experimental patterns, the matched pattern. The study was conducted with 56 third grade students at a state elementary school. The study used academic achievement test and attitude scale for mathematics as data collection tools. Within the mathematics class experiment group Fast Draw learning strategy was utilized and the control group was taught the course according to lesson plans prepared in accordance with various activities (reading, interpreting, visualization, and solving the problem). The findings of the study revealed that the Fast Draw Learning Strategy increased the students' academic achievement and their attitude towards mathematics positively.

Introduction

Mathematics has always been one of the most significant issues in an individual's life. Children need mathematics when they graduate from school or when they start working (Hannell, 2007).

One of the focal points of this study is the academic achievement of students in the mathematics course. Although much care is given to mathematics education, we can say that achievement in mathematics has not reached a desirable point and it is even getting worse today. Results of the studies acknowledge the existence of an ample number of problems based on the shortcomings in the quality of educational services (Gömleksiz, 1997).

Problems with mathematics at schools frequently result in failing at school and high levels of anxiety (Mercer & Miller, 1992). Inadequately designed educational methods and material are among the important factors that make learning mathematics hard for most of the students having problems in mathematics courses (Rivera, 1997). Thus, a more effective approach in mathematics education is needed (Mercer & Miller, 1992). It is expected from students that they should obtain basic mathematical facts and problem solving skills in order to be successful at school and in society. Unfortunately, the students have trouble in mathematics courses whether they suffer from learning disabilities or not. Understanding failure, however, contributes to solving the possible learning problems in mathematics (Miller & Mercer, 1997).

Like other subjects, mathematics teaching too was explained by behavioral learning theory from the 1950s to the 1970s. During this period, mathematical activities were based on intuition rather than scientific research methods. Learning mathematics was related to students' skills like retention, transfer, and recognition of mathematical information as measured by standardized tests (Kieran, 1994; cited in Rivera, 1997).

1970s and 1980s are the decades that represent a break away from the behavioral traditions and a transfer to the quest for cognitive models (Kieran, 1994). The use of cognitive strategies in learning mathematical content became a current issue during this period (cited in Rivera, 1997).

The structure of mathematical knowledge covers some skills, concepts, and strategies and all these are taught to children at schools before their application in real life situations (Cowan, 2006). According to Organization for Economic Cooperation and Development [OECD], the students need to be asked to use learning strategies that relate previous information and new information in mathematics courses (OECD, 2004). Moreover, the National Council of Teachers of Mathematics [NCTM], (2000) advises students to know about learning strategies and use these effectively (cited in Fogelberg, Skalinder, Satz, Hiller, Bernstein, Vitantonio, 2008).

The core findings of recent cognitive studies reveal that successful students display a greater ability in analyzing, planning, applying, and evaluating academic tasks. These skills include using learning strategies and problem solving skills (Alexander, Murphy, & Guan, 1998). According to Weinstein and Mayer (1986), a learning strategy covers the behavior the student uses during learning and it aims at influencing the students' process of coding. According to Guild (cited in The Ministry of National Education [MoNE], 2002), there is a different way, a different logic for teaching or learning a certain behavior. Learning strategies, too, need to focus on the strong points of students. The teachers' task is to find these ways. Learning strategies can be thought of learning for the learner, and a teaching strategy for the educator. As Weinstein and Mayer (1986) put forward, learning strategies based on a cognitive approach take the learning-teaching process as a process in which the students are active participants rather than passive receivers of information.

Within this context, it is important to secure that the students participate in the learning environment accompanied by various stimulants and be active learners in the learning process. It is only possible for students to become active learners in the learning environment through knowing the learning strategies and using these during learning.

The learning strategy used in this study is the Find-Ask-Set up-Tie down-Discover-Read-Answer-Write (Fast Draw) strategy. This strategy was devised by Mercer and Miller (1992) for students with learning disabilities in mathematics courses. Fast Draw strategy is one of the cognitive approaches used in mathematics (Rivera, 1997). This strategy covers the strategies of self-teaching, self-monitoring, and self-support. This strategy was devised to help students find the important information in the problem, set the mathematical procedure up in the right way, and solve the problem (Reid & Lienemann, 2006). Further, this strategy also helps students solve more complicated mathematical problems (Miller & Mercer, 1997). Most students with learning disabilities become passive when they have to solve a problem (for example they tend to guess the answer or avoid studying). When a problem solving strategy is used for these students they can become active and independent students. Fast Draw strategy helps students solve abstract mathematical problems (Mercer & Miller, 1992).

The other focal point of this study is the students' attitudes towards mathematics. Attitude, belief, and motivation play an important role in learning mathematics. Most of the students who experience trouble in learning mathematics have a history of failure in mathematics. As a result, they develop negative attitudes and feel insecure about their capacities in succeeding in mathematics courses. The National Council of Teachers of Mathematics [NCTM] and the National Council of Supervisors of Mathematics [NCSM] focus on the affective side of mathematics education and state that mathematics education should to be designed in order to secure academic achievement and develop positive attitudes (Mercer & Miller, 1992).

While attitudes affect achievement, achievement too affects attitude (Aiken, 1970). Pal (1989) observed that the students' who have more positive attitudes towards mathematics enable them to be more successful in mathematics courses. Jayraman (1989) found an important relation between the attitude towards mathematics and achievement in mathematics. These studies show that the students who have positive attitudes towards mathematics have better performances in mathematics tests when compared to those who have negative attitudes towards the subject. Mathematics education at elementary schools should be well planned and designed in order to develop positive attitude towards mathematics (cited in Saha, 2007).

This study investigates the ways in which the Fast Draw learning strategy affects academic achievement and attitudes towards mathematics in mathematics courses. There is a limited number of international studies, however, which argue that this strategy is only effective in the mathematical achievement of students with learning disabilities (Mercer & Miller, 1997; Cassel & Reid, 1996; cited in Butler, Miller, Lee & Pierce, 2001). On the other hand, we were not able to find any national or international study that evaluates the effects of this strategy on attitudes towards mathematics. Therefore, we think that this study will contribute to the field in both theory and application. Further, the study is also significant in offering solutions based on a different strategy to possible academic problems that may arise in mathematics courses at an early period and raising individuals with positive affective qualities.

Within this context, the study aims at exploring the effects of the Fast Draw learning strategy on academic achievement and attitudes towards mathematics in elementary third grade mathematics course. In order to meet these aims the following hypotheses were formulated:

1. There is a significant difference between the treatment group using the Fast Draw learning strategy and the control group using various activities in the posttest scores of the “Mathematical Achievement Test in favor of the treatment group.

2. There is a significant difference between the treatment group using the Fast Draw learning strategy and the control group using various activities in the posttest scores of the “Mathematics Attitude Scale in favor of the treatment group.

Turkish Contex

Elemantary Mathematics Curriculum in Turkey

Mathematics course is one of the courses in Turkey that occupies 4 hours of classwork in a week. A new mathematics curriculum was adopted in Turkey in 2005 taking national and international studies and other countries' mathematics curricula and Turkey's experiences in mathematics into consideration. This curriculum underlines mathematical concepts, the interrelationship of these concepts, the underlying meaning of the transactions, and the achievement of transaction abilities. Further, this curriculum covers such learning areas as “numbers,” “geometry,” “measuring,” and “data” (MoNE, 2009).

Method

Research Design

This study uses matched-pattern among the semi-experimental patterns. In this pattern, two of the present groups are matched based on specific variables. Matched groups are assigned to application groups randomly (Büyüköztürk, Çakmak, Akgün, Karadeniz, & Demirel, 2008).

Subjects

The study was conducted with 56 third graders attending a state elementary school in Hatay city’s central county. At the beginning of the experimental trial “Mathematical Achievement Test” and “Attitudes towards Mathematics” scales were administered in order to determine whether the groups were matched or not and the results of the t-test revealed that there was no significant difference (P>.05) between the pretest scores of the study groups. According to this criterion, among the matched study groups the class of 3/B was randomly assigned as the treatment group while the class of 3/A was randomly assigned as the control group.

Data Collection Tools

Mathematics Achievement Test

Mathematics achievement test has been developed by researchers covering problem solving with natural numbers. During the development of this achievement test, firstly an initial test with 45 items was prepared through a table of specifications within the framework of predicted objectives (28 objectives) for the *Numbers* learning field in the elementary third grade Mathematics Course Program. A total of 132 students attending a different state elementary school were given this test for the pilot study. The material analysis following the pilot study calculated each item’s difficulty and discrimination indexes. Items with below .30 discrimination indexes were discarded through the t-test and those items which show no difference between the lower and upper groups, 27% segments were regarded as non-discriminative and were also discarded from the test. The means of the items in the test are between .29 and .79, and the standard deviations are between .41 and .50. As a result, a mathematics achievement test comprising a total of 30 questions was obtained. The test’s KR-20 Confidence Coefficient was found to be .93. *(see Appendix A for e*xample of the *Mathematics Achievement Test*).

Mathematics Attitude Scale

In this study the “Mathematics Attitude Scale” developed by Baykul (1990) covering a range of students from the elementary fifth grade to high-school seniors was used to measure the students’ attitudes towards mathematics. The scale was commonly used by researchers in order to measure attitude towards mathematics in elementary schools in Turkey. The points in this Likert type scale was rated as “Strongly agree,” “Generally Agree,” “Neither agree nor disagree,” “Disagree,” and “Strongly disagree.” According to the results of the factor analysis, which was carried out in order to determine the structural validity of the scale, the variant that can be explained by a single factor was found to be 0.49. The Cronbach alpha value of this attitude scale comprising of a total 30 items –of which 15 reflect positive and 15 reflect negative attitudes- is 0.96. A student may score between 30 and 150 in the scale.

Another validity confidence study was done again because the participants of the study were third grade students. Therefore, the scale was applied to 142 third grade students. A factor analysis was done in order to determine construct validity of the scale and varimax rotation was applied. The items that revealed less than 0.40 in principal component analysis and in varimax rotation loads, and those that had high factor load under two different factors were discarded from the scale (Tavşancıl & Keser, 2002). According to the results of this application the remaining 27 items in the scale are in one factor and their factor loads vary between 0.673-0.827. Total variance explained by a single factor is 72.079. Since the scale has 27 items the expected lowest score is 27, while the highest is 135, and the range is 108. The mean value for the items in the scale is 2.44-3.76, while their standard deviation is between 1.50 and 1.66. The total correlation coefficients of the entries in the scale vary between 0.30 and 0.60 and the alpha confidence coefficient is .92. Some of the items included in this scale are: “Engaging in mathematics is fun for me”, “I fear the mathematics classes”, “Mathematics is among my favorite classes” and “I do not like mathematics at all.” *(see Appendix B for e*xample of the *Mathematics Attitude Scale*).

Procedure

In this study the data was collected during 8 weeks and in a total of 32 class hours. The courses were taught by their own teachers both in the treatment and the control group. The teachers and the students in the treatment and control groups were informed about the study. Firstly, the *Fast Draw learning strategy* was taught to the teacher and the students of the treatment group by using prepared exemplary texts and work sheets in a total of eight class hours. Following the completion of preparatory works, the same problems were taught in the mathematics course by using the *Fast Draw learning strategy* in the treatment group and by using various activities (reading, interpreting, visualization, and solving the problem) which are based on the prepared lesson plans. The teachers of control and experimental groups had similar characteristics (years of experience, education level, age).

Treatment Group Instruction

The teacher first asked the students to write down the problem in their notebooks in the study group. Then the teacher guided the students into solving the given problem using the steps of the Fast Draw learning strategy.

Below there is a sample problem used during the experimental procedures and solved according to the Fast Draw learning strategy.

Sample Problem: Mine wants to distribute 24 marbles equally to 6 children. How many marbles should Mine give to each child?

1. Find what you are solving.

In this step, the students were asked to look for and underline the question sentence. For example: *The students underlined the sentence* “How many marbles should Mine give to each child?”

- Mine wants to distribute 24 marbles equally to 6 children. <u>How many marbles should Mine give to each child?</u>

2. Ask yourself, "What information is given?”

In this step the students were asked to find and circle the number phrases in the problem. For example:

- Mine wants to distribute (24 marbles) equally to (6 children)

  <u>How many marbles should Mine give to each child?</u>

3. Set up the equation

In this step the students were asked to set up an equation using the numbers in the correct order. For example:

- 24 marbles-----6 children =

4. Tie down the sign

In this step, the students were asked to read the underlined question sentence and explain which operation they would use. For example, a student explained that the sentence "How many marbles should Mine give to each child?" means "division operation" and that 24 marbles would be divided into 6 children for Mine to be able to give each child an equal number of marbles.

- 24 marbles_÷_6 children=

5. Discover the sign

In this step the students were asked to discover the operation sign, circle it and state it. For example:

- 24 marbles (÷) 6 chidren=

6. Read the problem.

The students were asked to read aloud the newly formulated mathematical version of problem. For example: "The problem I want to solve is to divide 24 by 6."

7. Answer the problem or draw

In this step the students were asked to visualize the answer by drawing tallies and circles. For example:

24 marbles ÷ 6 children= _

1. The students drew as much as tallies as the number of the dividend (24)

I I I I I I I I I I I I I I I I I I I I I I I I

2. The tallies were circled according to the value of the divisor (6).

(I I I / I I I)   (I I I / I I I)   (I I I / I I I)   (I I I / I I I)

3. The number of the circles that showed the quotient were counted.

24 ÷6 = 4

8. Write the answer.
In this step the students were asked to write down their answers. For example, they wrote that the number of marbles that each child could get was 4.

- 24 marbles ÷ 6 children= 4

The teacher always guided the students while the above mentioned fast draw strategy was being applied. He tried to encourage the students to think about the problem by posing different questions especially within the first applications where the students had trouble. For example he asked: "Which operation should we use in order Mine to distribute the marbles equally to each child?" Further the teacher helped the students visualize their answers. *(see Appendix C for example of the FASTDRAW Dialog).*

Control Group Instruction
The students in the control group were firstly asked to read the given problem and to talk about it. Then a couple of students tried to visualize the problem. The students were asked to solve the problem on their own in their notebooks. The teacher checked the students' answers and the problem was solved by voluntary students on the board. After a student solved the problem on the board, the class discussed the shortcomings and faults and these, if any, were corrected.

Data were collected to examine the differences between the treatment and the control groups and these were tested and interpreted using the t-test for independent samples.

Results and Discussion

Data Analysis for Hypothesis 1

The effects of Fast Draw strategy on students' academic achievement were investigated by comparing the post-test scores of the students in the treatment group with the post-test scores of the students in the control group within the Academic Achievement Test (AAT). In order to determine whether the two groups match in academic achievement at the onset of the study, t-tests were performed on the pre-test scores for the AAT between the treatment group and the control group.

The analysis of pre-test scores for the AAT is presented in Table 1. This table shows that the treatment group's AAT pre-test mean score was 13.38 and the standard deviation was 5.69. The control group's AAT pre-test mean score was 13.46 and the standard deviation was 5.73.

Table 1: Analysis of Pre-Test Scores for the Academic Achievement Test (AAT)

Groups Compared	N	Mean	SD	df	t	P
Treatment Group	26	13.38	5.69	54	-.054	.957
Control Group	30	13.46	5.73			

* stands for p>0.05

Table 1 indicated that while the mean figure for the control group was slightly higher than that of the treatment group, the difference was not statistically significant [$t_{(54)}$= -.054, p>.05].

Analysis of Post-test Scores for the Academic Achievement Test (AAT)

Hypothesis 1 tested in this experiment put forward that there is a significant difference, between the treatment group using the Fast Draw learning strategy and the control group using various activities in the posttest scores of the "Mathematical Achievement Test in favor of the treatment group.

Scores obtained on the AAT were subjected to a t-test for independent samples. This procedure permitted comparison of the mean post-test scores to determine if there was a statistically significant difference between posttest scores of the two groups in academic achievement.

The analysis of post-test scores for the AAT is presented in Table 2. This table shows that the treatment group's mean post-test score was 19.76 and the standard deviation was 7.31. The control group's mean post-test score was 14.20 and the standard deviation was 6.55.

Table 2: Analysis of Post-Test Scores for the Academic Achievement Test (AAT)

Groups Compared	N	Mean	SD	df	t	P
Treatment Group	26	19.76	7.31	54	3.00	.004
Control Group	30	14.20	6.55			

* stands for p<0.05

Table 2 revealed that the difference between posttest scores of the treatment group and control group was statistically significant in favor of the treatment group [$t_{(54)}$=3.00, p<.05]. This indicates that the group which received instruction in Fast Draw strategy achieved significantly greater scores on the AAT. Consequently, Hypothesis 1 was accepted. This finding can be interpreted as the Fast Draw learning strategy has a positive impact on the students' academic achievement in mathematics.

A study by Mercer and Miller (1997) showed that the Fast Draw strategy increased the students' academic achievement in mathematics. Further, the study stated that the teachers and students taking the field tests received a high level of satisfaction from the program and that the teachers would be using this program in their courses again. In addition, Cassel and Reid (1996) have investigated the effects of this strategy in developing the mathematical skills of two students with learning disabilities in mathematics. The results of the study revealed that the problem solving skills of both students have improved (cited in Butler, Miller, Lee, & Pierce, 2001). The results of the current study are in line with this study's findings. Moreover, it can be argued that this strategy has an impact on academic achievement since it guides students into discovering the important information in the problem, setting up the arithmetic operations in a right way, and solving the problem (Reid & Lienemann, 2006).

Data Analysis for Hypothesis 2

The effects of Fast Draw strategy on the students' attitudes towards mathematics was investigated by comparing the post-test scores of the students in the treatment group with the post-test scores of the students in the control group on Mathematics Attitude Scale (MAS). In order to determine whether the two groups were matching in attitudes towards mathematics at the onset of the study, t-tests were performed on the pre-test scores for the Mathematics Attitude Scale (MAS) between the treatment group and the control group.

The analysis of the pre-test scores for the MAS is presented in Table 3. This table shows that the treatment group's MAS pre-test mean score was 89.37 and the standard deviation was 12.08. The control group's MAS pretest mean score was 85.96 and the standard deviation was 24.35.

Table 3: Analysis of Pre-Test Scores for the Mathematics Attitude Scale (MAS)

Groups Compared	N	Mean	SD	df	t	P
Treatment Group	26	89.37	12.08	54	.648	.519
Control Group	30	85.96	14.35			

* stands for p>0.05

Table 3 indicated that while the mean figure of the treatment group was higher than that of the control group, the difference was not statistically significant [$t_{(54)}$= .648, p>.05].

Analysis of Posttest Scores on the Mathematics Attitude Scale

Hypothesis 2 tested in the study showed that there is a significant difference between the treatment group using the Fast Draw learning strategy and the control group using various activities in the posttest scores of the "Mathematics Attitude Scale in favor of the treatment group".

MAS scores were subjected to a t-test for independent samples. This procedure permitted comparison of the mean post-test scores to determine if there was a statistically significant difference between the post-test scores of the two groups in attitudes towards mathematics.

The analysis of post-test scores for the MAS is presented in Table 4. This table shows that the treatment group's mean post-test score was 102.62 and the standard deviation was 18.75. The control group's mean post-test score was 75.60 and the standard deviation was 25.44.

Table 4: Analysis of Post-Test Scores for the Mathematics Attitude Scale (MAS)

Groups Compared	N	Mean	SD	df	t	p
Treatment Group	26	102.62	18.75	54	4.46	.000
Control Group	30	75.60	25.44			

* stands for p<0.05

Table 4 revealed that the difference between the post-test scores of the treatment group and control group was statistically significant in favor of the treatment group [$t_{(54)}$=4.46, p<.05]. This indicates that the group who received instruction in Fast Draw strategy got significantly greater scores on the MAS. Consequently, Hypothesis 2 was accepted. This finding can be interpreted as the Fast Draw learning strategy has a positive effect on the students' attitudes towards mathematics.

There are no studies in literature investigating the effects of the Fast Draw strategy on attitudes towards mathematics. Therefore, because the Fast Draw strategy is a learning strategy, this finding is related to those studies exploring the effects of *learning strategies* on attitudes towards some courses in a general way. The findings of the study are parallel to the study carried out by Belet and Yaşar (2007), which showed that learning strategies are effective in the students' development of positive attitudes towards Turkish classes, and to another study by Çerçi (2005), which again stated that learning strategies are effective in the students' development of a positive attitude towards Turkish classes. On the other hand, attitude is a phenomenon obtained by learning (Ülgen, 1995). Because the Fast Draw strategy enables students to learn mathematics through a different way, it may have increased the students' interests in learning. In this case it might have been effective in the students' development of a positive attitude towards math.

Conclusions and Implications

This study shows that the Fast Draw learning strategy carried out with elementary third grade students increase the students' level of academic achievement and their attitudes towards mathematics in a positive way.

In line with these results;
We can recommend that in order to increase academic achievement and to develop positive attitudes towards mathematics, the Fast Draw strategy may be used in 3rd graders' mathematics classes and the teachers and teacher candidates should be informed about these strategies.

This study is limited to third grade students regardless of their levels of learning in mathematics classes. Thus, future studies concentrating on different grades and different student levels in mathematics classes may contribute to eliminating learning disabilities in mathematics courses and therefore to establish the theoretical base of this strategy.

References

Aiken, L. R. (1970). Attitudes toward mathematics, *Review of Educational Research*, *40*, 551-596.

Alexander, A. P., Murphy, P. K. & Guan, J. (1998). The learning and study strategies of highly able female students in Singapore, *Educational Psychology*, *18*, 391-407.

Baykul, Y. (1990). *İlkokul 5. sınıftan lise ve dengi okulların son sınıflarına kadar matematik ve fen derslerine karşı tutumda görülen değişmeler ve öğrenci yerleştirme sınavındaki başarı ile ilişkili olduğu düşünülen bazı faktörler*, Ankara: ÖSYM Press.

Belet, D. Ş. & Yaşar, Ş., (2007). Effectiveness of learning strategies over reading comprehension, writing skills and learners' attitudes towards Turkish course, *Journal of Theory and Practice in Education*, *3*(1), 69-86.

Butler, F. M., Miller, S. P., Lee, K-H & Pierce, T. (2001). Teaching mathematics to students with mild-to-moderate mental retardation: a review of the literature, *Mental Retardation*, *39*, 20-31.

Büyüköztürk, Ş.,Çakmak, K.E.-Akgün, Ö. E., Karadeniz, Ş. & Demirel, F. (2008). *Social science research techniques*, Ankara:Pegem A Press.

Çerçi, A., (2005). Effects of learning to learn strategies on the comprehension level of the students during Turkish education, (Unpublished MS thesis), University of S.Ü., Konya, Turkey.

Fogelberg, E., Skalinder, C., Satz, P., Hiller, B., Bernstein, L., & Vitantonio, S. (2008). *Integrating literacy and math: strategies for K-6 teachers*. NY: Guilford Press.

Gömleksiz, M. (1997). *Cooperative learning.* Adana: Baki Press.

Hannell, G. (2007). *Success with inclusion: 1001 teaching strategies and activities that really work*. UK: Routledge.

Organisation for Economic Co-operation and Development (2004). Learning for tomorrow's world first results from PISA 2003. Paris: OECD Publishing.

Mercer, C. & Miller, S. (1992). Teaching students with learning problems in math to acquire, understand, and apply basic math facts. *Remedial and Special Education*, *13*, 19-35.

Miller, S. P. & Mercer, C. D. (1997). Teaching math computation and problem solving: a program that works. *Intervention in School & Clinic*, *32*, 185-191.

Ministry of National Education (2002). Student centered education practice model, Ankara: MEB Press.

Ministry of National Education (2009). *Mathematics Curriculum*. Retrieved June 30 2011, from, http://www.meb.gov.tr.
Reid, R. C., & Lienemann, T. O. (2006). *Strategy instruction for students with learning disabilities,* New York: Guilford Press.
Rivera, D. P. (1997). Mathematics education and students with learning disabilities: introduction to the special series, *Journal of Learning Disabilities, 30,* 2-19
Saha, S. (2007). Mathematics in relation to cognitive style and attitude towards mathematics, *Journal of Indian Education*, 13, 90-95.
Tavşancıl, E. & Keser, H. (2002). Development of a likert type attitude scale towards internet. *Journal of Faculty of Educational Sciences*, *1-2,* 79-100.
Ülgen, G. (1995). *Educational psychology: individual and learning,* Ankara: Bilim Press.
Weinstein, C. E. & R. E Mayer (1986). The teaching of learning strategies. In M.C. Wittrock (Ed.) *Handbook of research on teaching* (pp. 315-327). New York: Macmillan Company.

APPENDIX A

Example of the Mathematics Achievement Test

1- How many meters does a tortoise which moves forward at 60 meters per hour proceed at 5 hours?
a. 250 b. 300 c. 600

2- There are 12 seats in a bus. 9 people were sitting on each seat. 8 people got off the bus in the first bus-stop. How many passengers were there left in the bus?
a. 105 b. 95 c. 100

3- The number of male passengers in a plane is 162. The number of female passengers is 57 less than the number of male passengers. How many passengers are there in the plane?
a. 219 b. 225 c. 267

4- When Selin is 9 years old, her mother is 32 years old. How old would Selin be when her mother is 40 years old?
a.17 b. 19 c. 25

5- A stationary seller sells 5 dozens of pencils in the morning, 10 bunches of pencils in the evening. How many pencils does he sell a day, totally?
a. 160 b. 100 c. 60

6- I am 7 years old. My father's age is 4 more than my age's 5 times. What is the grandtotal of my and my father's age?
a. 46 b. 45 c. 49

7- Kaan's father bought him a 44-page-fairy tale book. Kaan read 6 pages a day. How many pages are there left at the end of the 5th day?
a. 15 b. 16 c. 14

8- I am getting around the circle of a playground whose peripheral length is 124 meters in 4 minutes. If so, how many meters do I proceed in 1 minute?
a. 41 b. 31 c. 5

APPENDIX B
Example of the Mathematics Attitude Scale

Number of Items		I totally agree	I usually agree	I am uncertain	I don't agree	I never agree
1	Mathmetics is among the lessons that I love very much.					
2	Studying Mathmatics makes me rest.					
3	I would be happy if the topics in Maths were decreased.					
4	Dealing with Maths makes me enjoy.					
5	I enjoy studying Maths in my free time.					
6	I am afraid of topics in Maths.					
7	Solving a problem in Maths makes me tired.					
8	Maths looks scary for me.					
9	I enjoy solving a problem in Maths.					
10	Maths is the most beautiful subject among the subjects.					
11	In the future, I would like to choose a profession which is closely relevant to Maths.					
12	I don't like Maths at all.					
13	I would be happy if the hours of subject Maths were diminished.					
14	In the future, I would like to choose a profession which is the least relevant to Maths.					
15	I want to solve every problem in Maths that I could find.					

APPENDIX C
Example of the FASTDRAW Dialog

Sample Problem: Our school has 7 floors. There are 12 classrooms on each floor. How many classrooms are in our school?

1. Find what you are solving.

In this step, the students were asked to look for and underline the question sentence. For example: *The students underlined the sentence* "How many classrooms are in our school?"

Our school has 7 floors. There are 12 classrooms on each floor. <u>How many classrooms are in our school?</u>

2. Ask yourself, "What information is given?"
In this step the students were asked to find and circle the number phrases in the problem. For example:
Our school has (7 floors). There are (12 classrooms) on each floor. <u>How many classrooms are in our school?</u>

3. Set up the equation
In this step the students were asked to set up an equation using the numbers in the correct order. For example:

- 7 floors-----12 classrooms =

4. Tie down the sign
In this step, the students were asked to read the underlined question sentence and explain which operation they would use. For example, a student explained that the sentence "How many classrooms are in our school?" means "multiplication operation"

- 7 floors <u>X</u> 12 classrooms =

5. Discover the sign
In this step the students were asked to discover the operation sign, circle it and state it. For example:

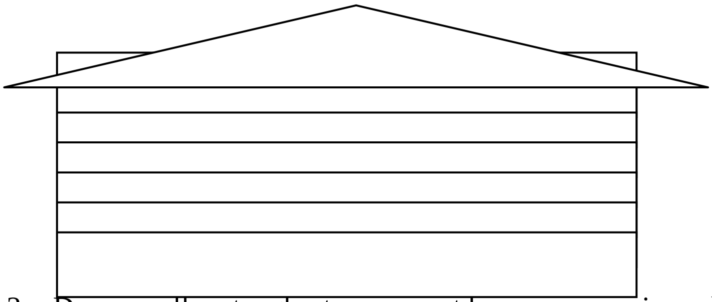
- 7 floors (**x**) 12 classrooms=

6. Read the problem.
The students were asked to read aloud the newly formulated mathematical version of problem. For example: "The problem I want to solve is to multiply 7 by 12."

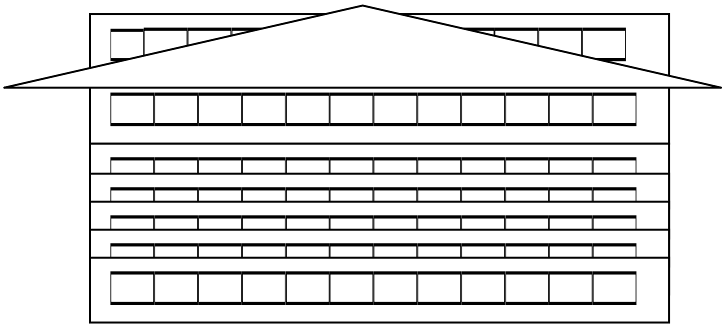
7. Answer the problem or draw
In this step the students were asked to visualize the answer by drawing rectangles. For example:

- 7 floors (**x**) 12 classrooms=_

1. Draw rectangles for the number of groups.



2. Draw small rectangles to represent how many are in each group.



3. Add the small rectangles in all rectangles and write the total

7 x 12 = 84 – “7 groups of 12 equals eighty four”

8. Write the answer.
In this step the students were asked to write down their answers. For example, they wrote that the number of classrooms was 84 in the school.

7 x 12 = 84