European Journal of Educational Research
Volume 6, Issue 2, 157 - 174.
ISSN: 2165-8714
http://www.eu-jer.com/

Reflections from the Application of Different Type of Activities: Special Training Methods Course*

Mihriban Hacisalihoglu Karadeniz **
Giresun University, TURKEY

Received: March 11, 2017 ▪ Revised: March 27, 2017 ▪ Accepted: April 5, 2017

Abstract: The aim of this study is to reveal the benefits gained from "Special Training Methods II" course and the problems prospective mathematics teachers encountered with it. The case study method was used in the study. The participants in the study were 34 prospective mathematics teachers studying at a Primary School Mathematics Education Department. The data collection tools were a form composed of open-ended questions and semi-structured interviews. Descriptive analysis of the quantitative data was carried out. In the "Special Teaching Methods II" course, beginning in the spring term of the 2015-2016 academic year, teaching activities on "multiple intelligences", "discovery", "group work", "problem-solving", "history of mathematics" and "computer-assisted teaching" were developed and implemented. It was concluded that these activities helped students like mathematics more, understand the importance of helping each other and cooperation and have more enjoyable lessons, as well as aiding their cognitive, social and emotional development. It was also found that through these activities participants improved their belief in themselves and increased their confidence regarding teaching mathematics. The participants also faced with some difficulties during the application process. They mostly mentioned that preparing worksheets was time-consuming, finding a school to perform the activity was hard and students were reluctant.

Keywords: *Mathematics education, mathematics activities, special training methods, prospective teachers.*

To cite this article: Hacisalihoglu Karadeniz, M. (2017). Reflections from the application of different type of activities: special training methods course. *European Journal of Educational Research*, *6*(2), 157-174. doi: 10.12973/eu-jer.6.2.157

Introduction

Activity may be defined as a planned task which aims to provide the students with the gains in the curriculum (Bransford, Brown and Cooking, 2000) and applications which allow students to use mathematical expressions and symbols, create models and engage in reasoning and abstraction (Baki, 2008). In other words, activity may be defined as a task, which attracts the interest of the student, is a part of everyday life and puts the student in the center (Bukova-Guzel & Alkan, 2005). An activity should be interesting and educational, selected from daily events, have a defined purpose, enable students to interact and collaborate, allow students construct their knowledge by using their previous experiences and preliminary learning, make efficient use of time, motivate students and encourage them to think, discuss and predict (Dreyfus & Tsamir, 2004; Doolittle, 2000; Epstein & Ryan, 2002; Ishi, 2003; Kerpic, 2011; Ozmantar & Bingolbali, 2009; Saunders, 1992; Watson, 2008). On the other hand, Ainley, Pratt and Hansen (2006) emphasizes that purpose and applicability principles are important when developing an activity.

Mathematical tasks are given great importance in the United States in order to improve the quality of mathematics education and support the learning of a certain concept (Simon and Tzur, 2004). National Council of Teachers of Mathematics (NCTM) highlights the importance of student-centered mathematics education through application of various activities (NCTM, 2000). In the updated middle school mathematics curriculum and textbooks in Turkey, it is noted that subjects should be taught through activities (Ministry of National Education [MNE], 2013). The curriculum aims to create situations where students make discoveries on their own through learning-based activities and easily learn by understanding (Bulut, 2008). Considering that the curriculum expects subjects or concepts are taught through activities (MNE, 2005), it seems that there is a conflict instead of a common perception as far as the application of the curriculum through activities goes and therefore there are problems about the quality and the implementation style of

* A part of this study was verbally presented in the conference titled "International Conference on New Horizons in Education" (2016, Vienna, AUSTRIA).

**Correspondence:
Mihriban Hacisalihoglu Karadeniz, Giresun University, Faculty of Education, Department of Mathematics and Science Education Giresun, Turkey
Email: mihrideniz61@gmail.com

activities (Bozkurt, 2012). On the other hand, some studies reveal that teachers are not able to develop activities or perform developed activities in their classes (Duatepe-Paksu and Akkus, 2007) or are not interested in and willing to perform activities due to certain reasons (Bal, 2008; Ozpolat, Sezer, Isgor and Sezer, 2007).

The content of the Special Training Methods (STM-I and STM-II) course involves field-specific basic concepts and the relation of these concepts with the teaching in the field; general objectives of the teaching in the field; methods, techniques, tools and materials used; and review and assessment of the relevant curriculum and textbooks. In addition, the course requires teaching of problem-solving, numbers and operations, algebra, geometry, measurement, data processing and probability and involves planning, presentation and assessment activities (CoHE, 2007). Therefore, prospective teachers are expected to be informed about strategies, methods and techniques required by the STM course which they take at undergraduate level and be able to apply these strategies, methods and techniques when they start their service. However, it is reported in the literature that teachers prefer teaching methods and techniques such as direct instruction or question-answer, are not sufficiently equipped (Okur-Akca, Akcay & Kurt, 2016) and usually use the question-answer technique, the expository teaching strategy and discussion and direct instruction methods (Temizoz & Ozgun-Koca, 2008). Teachers show the busy curriculum and the concern for not being able to keep up with the schedule as the reasons behind this situation and express that they do not use different teaching methods in different classes (Temizoz, 2005). Although studies on activities are available in the literature, there is no study in which prospective teachers apply activities which they developed in the STM-II course to middle school students and which points out to resulting situations to the best of our knowledge. For this reason, this study is significant in that it reveals opinions of prospective teachers about the applicability of activities which they developed and determines potential gains of middle school students via these activities. In this context, prospective teachers developed mathematical activities in accordance with principles specified in the curriculum and the study addressed how these activities are applied within the process. Thus, the purpose of this study is to reveal outcomes achieved through and problems encountered during the application of activities related to multiple intelligences, discovery, group work, problem-solving, history of mathematics, mathematical rules and computer-assisted teaching. To this end, the study seeks to answer the following questions:

1. What are the difficulties encountered by prospective mathematics teachers during the “STM-II” course?

2. What are the opinions of prospective mathematics teachers about gains provided by activities developed in the “STM-II” course for middle school students?

3. What are the gains provided by activities developed in the “STM-II” course for prospective teachers?

Methodology

The study utilizes the qualitative research approach. The qualitative research method is used for the systematic examination of meaning derived from the experiences of individuals participating in the research (Ekiz, 2013). Qualitative studies have important characteristics such as creating an awareness of the natural environment, adopting a holistic approach, revealing the perceptions of participants, being flexible and performing an inductive analysis (Yildirim & Simsek, 2011). Taking these characteristics into account, the present study was designed as a case study approach which requires the use of multiple data collection tools by the researcher to gather detailed and in-depth information about real life events, a certain situation, a certain time period or limited situations within a group (Creswell, 2013; Yildirim & Simsek, 2011). The present study focuses on a limited situation and attempts to gather in-depth information, thus employs the case study method.

Participants

The study was carried out with 34 prospective teachers attending the fourth-year of Elementary School Mathematics Teaching Department, Faculty of Education in a state-owned university. 28 of the participants were female and 6 were male. The prospective teachers participating in the study were coded as P1, P2, P3, P4, P5, ..., P34 in accordance with research ethics.

Data Collection and Analysis

A form consisting of open-ended questions was used in this study in order to reveal opinions of participants about gains achieved through and problems encountered during mathematical activities which they constructed and applied in the STM-II course. The form included questions regarding gains achieved through and problems encountered during the application of activities related to multiple intelligences, discovery, group work, problem-solving, history of mathematics, mathematical rules and computer-assisted teaching. The questions in the form used in the study were prepared with the help of the literature and opinions of two experts on the subject were received. The content and prediction validity of

questions in the form was ensured by receiving opinions of three faculty members specializing on the field. Lastly, comprehensibility of the questions was examined by a Turkish language professor and the form took its final shape.

The qualitative findings obtained using the form were applied descriptive analysis. Tables were created based on common views of the participants. Frequency values were used when creating the tables. It is of great importance in terms of validity in a qualitative research to report the data collected in detail, include direct quotes from the participants and present results obtained (Yildirim & Simsek, 2005). For this reason, direct quotes were used in this study to reflect the opinions of the participants and present findings to the reader in a organized and interpreted manner. Quotes from prospective teachers were included with each code.

The Application Process of The Activities Constructed by The Participants

The prospective teachers made use of experiences of the researcher and various studies in the literature when developing the activities given in the table below. The title, the purpose and the participant count of each activity carried out in the STM-II course can be seen in the table below. It should be mentioned that prospective teachers received help from experts to develop the activities.

Table 1. Multiple Intelligences Activity

	Activity's Name	Activity's Purpose	Number of Participants
1	Versatile Thinking with Fractions	To perform addition and subtraction with two fractions with common denominators or two fractions, where the denominator of one is a multiple of the other.	32
2	The Frog Olympics	To help students conversions between meter-kilometer and meter-centimeter-millimeter units.	25
3	Solve It	To allow students to understand that the number of unit cubes placed in a rectangular parallelepiped without leaving any space is the volume of the parallelepiped.	24
4	Working with Polygons	To perform calculations related to diagonals of polygons and interior and exterior angles of polygons.	22
5	I'm Learning Polygons	To determine similarity rate of similar polygons and draw equivalent or similar polygons.	22
6	Working with Equations	To solve first-order equations with a single variable and make correct judgments in accordance with the problem-solving approach.	20
7	I Have Lots of Intelligence	To find out that the cylinder consists of a rectangle and two circles and the sum of areas of these shapes gives the area of the cylinder.	20
8	Using Our Intelligence	To arouse interest in and willingness to learning and to improve versatile thinking skills.	19
9	The Meter Block	To learn length measuring units and conversions between units and solve problems related to measurement.	19
10	Discovering Ourselves	To create desired steps of numbers and shape patterns with defined rules.	18
11	Let's Think	To create images of point, line segment and other planar shapes under rotation.	18
12	Painting with Fractions	To order fractions with common denominators or two fractions, where the denominator of one is a multiple of the other.	18
13	Multiple Intelligences, Multiple Learning	To allow students guess the area of a predefined area in terms of square centimeter and square meter.	18
14	The Magical Cube	To find and show the square and the cube of a natural number.	15
15	Mathematics and Art	To perform tasks aimed at identifying transformations found in various patterns and ornaments.	14
16	Pythagoras in Our Lives	To solve everyday problems by establishing the Pythagorean relation.	11
17	Think Hard and Win	To have students discover that corresponding points are equally distant from the line of symmetry in a folded image and the shape and its image are equivalents.	11

As shown in the table above, the participants prepared 17 “Multiple Intelligences” activities dealing with different intelligence domains.

Table 2. Group Work Activity

	Activity’s Name	Activity’s Purpose	Number of Participants
1	Let’s Work in Groups	To enable students solve problems by cooperating with each other.	38
2	Multiplication-division	To help students with their cognitive development as well as affective development through operations with numbers in groups.	30
3	Number Patterns	To allow students to learn the relationship between sets and sub-sets and the relationship between numbers in the Pascal’s triangle and numbers in consecutive sub-sets.	30
4	The Detective	To address prime numbers and their properties.	28
5	Let’s Work with Points Today	To find the relationship between the shapes and the point count. To find the relationship between the steps and the point count.	28
6	Our Tangram	To improve spatial-visual and spatial-rotational skills and classify shapes using Tangram.	25
7	Live Healthy	To convert calories burnt into time measurement units and gain data analysis and interpretation skills.	25
8	Group Syrup	To allow students better learn concepts through group work while having fun.	24
9	Creating Equivalent Fractions by Folding Papers	To improve communication skills and use problem-solving, reasoning and logical thinking skills efficiently.	20
10	Let's Do It Together	To name and classify polygons.	20
11	Brand New Ideas	To help students suggest new mathematical ideas.	19
12	Safety in Numbers	To allow students to collaborate toward a common goal and gain confidence.	19
13	From The Specific to The General, from The General to The Most General	To perform activities aimed at examining number and shape patterns and arithmetic sequences and expressing the rule of the sequence using a variable (e.g. n).	16
14	Pinocchio and The Money Pouch	To ensure active participation and effective communication through group work.	15
15	Working with Whole Numbers	To compare and sort whole numbers.	15
16	A Basket of Apples and The Car Dealer	To solve a higher-order problem using Polya's problem-solving steps.	14

As shown in the table above, the participants prepared 16 “Group Work” activities dealing with different subjects.

Table 3. Problem-solving Activity

	Activity’s Name	Activity’s Purpose	Number of Participants
1	The Mystery of Whole Numbers	To solve problems related to whole numbers.	28
2	Whole Numbers/All Numbers	To allow students solve problems requiring operations with whole numbers easily.	28
3	Solving Equations	To teach students how to solve equations.	26
4	Forming Patterns	To improve problem-solving and reasoning skills while forming patterns.	25
5	I’m Having Fun While Solving Problems	To solve a given problem in accordance with Polya’s problem-solving steps.	22
6	I’m Solving Problems!	To perceive and evaluate problems and use reasoning and logical thinking skills efficiently.	22

Table 3. Continued

	Activity's Name	Activity's Purpose	Number of Participants
7	Working with Problems	To learn, apply and make associations between problem-solving steps.	20
8	Old MacDonald's Farm	To transfer situations encountered in everyday life to mathematics using Polya's problem-solving steps.	20
9	Let's Solve	To identify problematic situations and suggest solutions.	18
10	Let's Solve Problems	To improve problem-solving skills, to learn problem-solving steps and improve mathematical thinking	16
11	Gain or Loss?	To solve a problem in accordance with problem-solving steps.	15
12	The Road Is Ours	To solve problems related to ratio and proportion.	15
13	It's Time to Solve Problems	To interpret the time chart given and understand the concept of time by solving problems.	15
14	Get The Frog out of The Well	To solve problems using Polya's problem-solving steps.	14
15	I Love Equations	To learn how mathematics is expressed by equations through examples from everyday life and understand equations.	12
16	My Problem Strategy	To develop new strategies while solving problems.	11
17	For How Many Years, Months and Days Are We Alive?	To arouse interest in and willingness to learning, increase learning responsibility and improve versatile thinking skills in decision-making process.	10

As shown in the table above, the participants prepared 17 "Problem-solving" activities dealing with different subjects.

Table 4. History of Mathematics Activity

	Activity's Name	Activity's Purpose	Number of Participants
1	Sieve of Eratosthenes	To allow students learn the historical development of mathematics and value mathematics.	30
2	Ataturk and Geometry	To allow students learn about the history of mathematics by showing the importance placed by and contributions of Ataturk to mathematics.	30
3	Fractals in Our Lives	To raise awareness in students by pointing out the place of fractals in the history of mathematics.	30
4	Ancient Egyptian Mathematics	To help students understand place values of digits in the decimal number system and the reason behind the transfer in addition.	25
5	Euclid's Algorithm	To allow students to discover Euclid's cathetus correlation.	24
6	Dealing with The Sieve of Eratosthenes	To help students find prime numbers up to 100 using the sieve of Eratosthenes.	24
7	Getting to Know Pythagoras and His Relation	To help student establish the Pythagorean relation and solve problems by teaching them the place of Pythagoras in the history of mathematics.	20
8	Guess and Find	To help students explain and share their mathematical ideas in a logical way by using the mathematical terminology and language correctly.	19
9	Leonardo Da Fibonacci	To allow students to discover that mathematics exists in nature and everywhere and realize beauties of mathematics.	18
10	Getting to Know al-Khwarizmi	To inform students about the history of mathematics by introducing al-Khwarizmi.	17
11	Pearls from Sierpinski	To introduce the famous Polish mathematician Waclaw Sierpinski and his contributions to science.	17
12	Sino-Japanese Numbers	To examine the development processes of mathematics in different civilizations.	15
13	Solving A Eratosthenes Puzzle	To explain Eratosthenes' contribution to the history of mathematics.	15

Table 4. Continued

	Activity's Name	Activity's Purpose	Number of Participants
14	Guess Who I Am	To introduce significant mathematicians in the history of mathematics.	15
15	Napier's Bones	To show students how mathematics was transfered from the past to this day and how mathematical operations are performed.	14
16	The Legend of 1729	To teach students that 1729 is the smallest number expressible as the sum of two cubes in two different ways.	14
17	Fibonacci and Sequential Numbers	To help students find the pattern of the Fibonacci number and calculate sequential numbers.	14
18	Mayan Numbers	To help students see the progressing and developing history of mathematics through number systems used by different civilizations.	12

As shown in the table above, the participants prepared 18 "History of Mathematics" activities dealing with different subjects.

Table 5. Rule Teaching Activity

	Activity's Name	Activity's Purpose	Number of Participants
1	Working with Darts	To teach students each outcome has an equal probability in events with equal chance and the value here is 1/n.	30
2	I'm Learning The Associative Property of Addition	To teach the commutative, associative and absorbing element properties of addition in rational numbers and the distributive property of multiplication over addition and subtraction.	30
3	Learning Patterns	Help students find rules of a pattern.	25
4	De Moivre's Calculation	To help students realize the ability to measure time.	25
5	Square Root Expressions	To allow students understand the importance of square root expressions in mathematics.	24
6	Analyzing The Data	To teach students how to summarize and interpret data shown in frequency tables, column charts or tree diagram.	21
7	What's Going to Come out of Patterns?	To allow students to express rules of arithmetic series and find the desired term expressed in letters.	20
8	Discovering The Relation in Polygons	To perform calculations related to diagonals of polygons and interior and exterior angles of polygons.	20
9	Obtaining Geometric Shapes	Help students find the relation between points of geometric shapes.	20
10	Definitions in Mathematics	To allow students see relations between concepts, reach generalizations, make estimations based on the rule and improve inductive and mathematical thinking skills.	19
11	Studying Fractions with Smurfs	To teach how to compare unit fractions, make denominators equal and recognize equivalent fractions.	18
12	Not Without Rules	To point out the importance of mathematical rules which we use in everyday life.	18
13	Whole Numbers in My Mind	To choose the right strategy for mental addition and subtraction with natural numbers.	18
14	Think About It	To teach students the rules of division and help them transfer these rules to new situations or associate the rules with everyday life.	15
15	How About Working with Cylinders?	To calculate the volume of the cylinder and find the pattern between volumes of two cylinders whose diameters are doubled	14
16	Party Hat	To give examples for the use of cone in everyday life and help them find volume and area of cone.	12

As shown in the table above, the participants prepared 16 "**.** Rule Teaching" activities dealing with different subjects.

Table 6. Discovery Activity

	Activity's Name	Activity's Purpose	Number of Participants
1	Interior and Exterior Angles	To identify diagonals and interior and exterior angles of polygons and calculate the sum of interior and exterior angles.	30
2	Finding Formulas	To construct new knowledge using the preliminary knowledge of students and thus show them how formulas are derived.	25
3	My Sugar Cube	To establish the volume relation through models considering that the cube is a special case of the rectangular parallelepiped.	24
4	Angles in My Body	To name and draw polygons and recognize main elements of polygons such as the edge, interior angle, corner and diagonal.	22
5	Linear Equations	To draw graphs of linear equations and express how two variables with linear correlation change depending on each other via tables, graphs and equations.	21
6	Brain Storming	To form structures whose drawings from different perspectives are given.	20
7	My Absolute Value	To teach how to determine the absolute value of a whole number.	20
8	The Discovery of The Day	To find the general pattern by finding the relation between the edge length of a square drawn in a circle, whose radius changes at each step, and the area of the isosceles right triangle in each square.	20
9	Learning The Square Root	To teach students how to determine the relation between square natural numbers and square roots of these numbers.	20
10	Let's Discover Together	To create the image of a planar shape created as a result of successive displacements and reflections.	18
11	Vulture Circle	To measure the length of a circle and the arc of a circle and the area of a circle and a circle segment.	18
12	Let's Play with Legos	To calculate the volume of a shape by counting unit cubes.	18
13	I Found A Model	To associate a percentage with a fraction or decimal notation corresponding to the same greatness and show conversions between these notations via a model.	18
14	My Exponential Numbers	To find and show the square and the cube of a natural number.	18
15	Percentages on Windows	To allow students to calculate the amount corresponding to a certain percentage of a quantity and express a quantity as the percentage of another quantity.	15
16	Acute, Right and Obtuse Angles	To teach students form acute, right and obtuse angles and recognize acute, right and obtuse angles.	14
17	Let's Make Lemonade	To teach students liquid measuring units and conversions between these units and help them make comparisons.	11
18	Let's Find The Perfect Square and The Difference of Two Squares	To teach students the perfect square and the difference of two squares.	10

As shown in the table above, the participants prepared 18 "Discovery" activities dealing with different subjects.

Table 7. Computer-assisted Mathematics Activity

	Activity's Name	Activity's Purpose	Number of Participants
1	Forming Bisectors with GeoGebra	To determine the bisector by dividing an angle into two equal angles using GeoGebra.	30
2	Learning Fraction Technology	To sort and compare fractions using the CD about fractions.	24
3	Coordinates in Our Lives with GeoGebra	To teach students the subject of rotation on the coordinate plane using GeoGebra and help them find desired points on the coordinate system using slides.	22
4	Fractals in Our Lives	To allow students to discover the mathematics in everyday life using computer-assisted teaching.	20
5	GeoGebra and Us	To show how to rotate points, line segments and planar shapes in GeoGebra.	20
6	Do We Know Geometric Shapes/Objects?	To teach students geometric shapes/objects with the help of computer-assisted teaching.	20
7	I Know Multipliers and Multiples	To help students determine multipliers and multiples of natural numbers. Teach the rules of division by 2, 3, 4, 5, 6, 9 and 10 without remainder.	15
8	Finding The Elements of Triangle Using GeoGebra	To help students discover bisectors and medians of triangle.	14
9	Let's Do The Math with Sketchpad	To teach the difference between patterns and ornaments.	13

As shown in the table above, the participants prepared 9 "Computer-assisted Mathematics" activities dealing with different subjects.

The participants were given three weeks to determine activity types, content and their group mates. At the end of three weeks, the participants presented their activities in the classroom. The names of the activities were determined as a result of cooperative work of each group. The participants were asked to form groups consisting of at least two and at most four members. Groups were created in the study since it is stated in the literature that activities should be designed in a way that they will allow students work in groups (Kayaaslan, 2006) and should also involve situations requiring both group and individual work (Baki and Gokcek, 2005; Baki, 2008). The participants were asked to take photos during the performance of activities and complete the activities two weeks prior to the end of the semester. The participants were interviewed during class hours each week and asked to prepare reports for each activity. The reports prepared by the participants were examined and feedback was given on how to perform the activity in the next class. Once the activities were completed, groups made presentations about their activities in the last class of the semester. As an example, the application processes of four different activities (history of mathematics, theory of multiple intelligences, teaching rules and problem-solving activities) are presented below:

History of Mathematics Activity

Figure 1 shows reflections from the activity "*Napier's Bones*". The aim of this activity was to show students how mathematics was transfered from the past to this day and how mathematical operations were performed in the past. The students were also explained that mathematics is man-made and not sent from heavens. Before the application, the appropriate ones were selected among worksheets on "*History of Mathematics*" prepared for 5th graders depending on the gains desired and the subject. After consulting with the responsible teacher of the school providing the internship program, the students were explained the purposes of the worksheets. The activities were distributed to 18 students. After wishes of good luck, the students were told that they could ask for help from the participants should they have any difficulties. The application was carried out on an individual basis by 14 students due to the low classroom size. The students were asked to read the text at the beginning of the worksheet involving two activities each having seven questions. The students were told to answer the questions in accordance with instructions. In a nutshell, the text involved a story about how to multiply numbers using the Napier's bones method. It was observed that three students answered all of the questions correctly, however the students generally had difficulty in answering the questions in the activities.

Figure 1. Reflections from the "Napier's Bones" activity

Theory of Multiple Intelligences Activity

Figure 2 shows reflections from the "*Discovering Ourselves*" activity. The purpose of this activity was to adopt an approach which considers individual differences of students and regulates the teaching process according to these individual differences and to help students realize these differences and value mathematics and also themselves.

Prior to the application, the participants prepared a worksheet for 8th graders about the "*Theory of Multiple Intelligences*". After consulting with the responsible teacher of the school providing the internship program, the students were explained the purposes of the worksheets. The application was carried out in groups of two with the participation of 18 eighth grade students. In the beginning, the students showed a prejudiced attitude toward the activity and thought that they could not answer the questions. It was observed that these prejudices diminished once the students reviewed the worksheet.

Figure 2. Reflections from the "Discovering Ourselves" activity

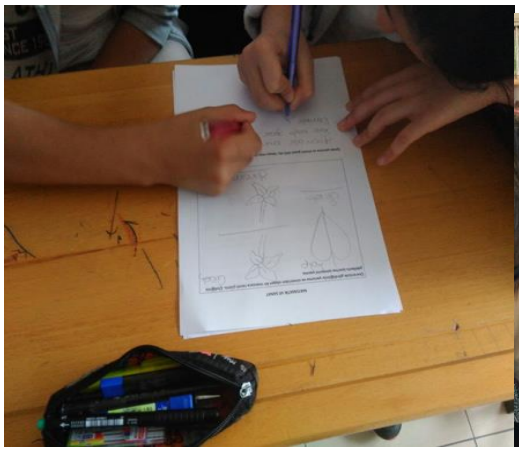

Figure 3. Students writing a story

Figure 4. Students drawing

As stated in Gardner's "Theory of Multiple Intelligences", worksheets were prepared to consider individual differences of students and regulate the teaching process according to these individual differences. The students stated that they found the activity to be fun and it was observed that they had a good time because they were offered learning experiences appealing to all senses and given the opportunity to play an active role in learning (Baki, Gurbuz, Unal & Atasoy, 2009). It was found as a result of the activity that the students identified the intelligence domain which suited them the best and drew pictures and wrote stories and poems accordingly. The students realized their capacity to create a product, their ability to come up with effective and efficient solutions for real life problems, their ability to solve new and complex problems which need to be addressed and thus discovered themselves. Moreover, the activity attracted the attention of middle school students since it helped them get to know themselves and the students expressed that they discovered their intelligence type at the end of the application.

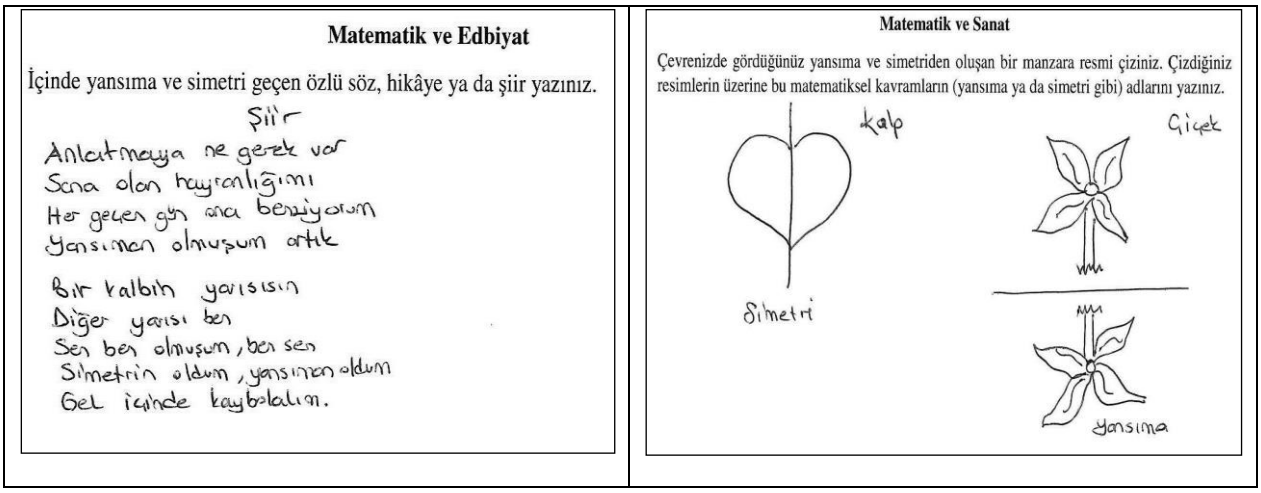

Figure 5. A picture drawn and the poem written by one of the students participated in the activity

Rule Teaching Activity

Figure 7 shows reflections from the "How About Working with Cylinders?" activity. The prospective teachers who supervised the activity aimed to have students calculate the volume of the cylinder and find the pattern between volumes of two cylinders whose diameters were doubled. Prior to the application, the students were reminded how to calculate the volume of the cylinder. The students found the subject to be fun and enjoyable. The participants guided them in cases where students had difficulties in understanding the subject. In spite of the guidance provided by the participants regarding the performance of the activity, 14 students asked for help from the prospective teachers on how to perform the activity. The reason why the students had difficulties might be because they could not discover the relation over the pattern. After the application, the worksheets completed by the students were evaluated and it was detected that they had difficulties in finding the rules and relations using the operational steps.

Figure 7. Reflections from the "How About Working with Cylinders?" activity

Problem-solving Activity

The aim of the "Whole Numbers/All Numbers" activity was to identify the problem situation and look for solutions. Prior to the application, the participants prepared a worksheet for 8th graders about problem-solving. The group work method was used when performing the problem-solving activity. The application was performed with 16 eight grade students assigned to 8 groups of two. The worksheet related to whole numbers was introduced to the students prior to the application. After necessary explanations, the students were handed the worksheet consisting of 8 questions and asked to read the instruction at the beginning of the worksheet. The students were asked to solves the given problem in the first activity, to write down problem steps in the second activity and form a problem in the third activity.

Figure 8. Reflections from the "Whole Numbers/All Numbers" activity

Figure 9. Reflections from the end of the application process of the problem-solving activity

The worksheets completed by the students were evaluated after the application and it was found that most groups participating in the activity answered all of the questions correctly, whereas the group with the least number of correct answers had 3 correct answers. At the end of the application process, it was seen that almost all of the students answered problems in the activities successfully without difficulty.

Findings / Results

The findings obtained according to sub-problems of the study are given below in tables.

Findings Related to The Difficulties Encountered by Prospective Mathematics Teachers During The "STM-II" Course

Table 8. Difficulties encountered by prospective teachers

Themes	Categories	f
Student	Students are reluctant.	14
	Students do not understand some subjects fully.	3
	Some students do not answer questions in activities carefully.	2
	Some students have difficulties answering questions in activities.	2
	Students do not want to perform activities.	2
	Some students believe that they cannot answer questions in worksheets.	1
	I do not know the achievement level of the class prior to the application.	1
Prospective Teacher	It is difficult to control the class while performing the activity.	3
	It is difficult to prepare a worksheet which suits the subject.	2
	It is difficult to prepare questions which addresses more than one type of intelligence.	2
	It is difficult to find examples from everyday life.	1
	It is difficult to prepare problems.	1
	I feel incompetent to use the smart board.	1
Time	It is time-consuming to prepare worksheets.	5
	Students have a low level of preparedness.	1
	It is difficult to find appropriate class hours to avoid disruption of regular course schedule of the school.	1
	It is time-consuming to examine answers of students.	1
School	It is difficult to find a school to perform the activity.	4

Some of the participant opinions regarding codes derived from "Prospective Teacher", "Student" and "Time" themes given in Table 8 can be found below.

"The students... did not want to participate in the application process and made a fuss about it... (K19)"

"It took me more time than I expected to prepare the worksheet. (P3)"

"We encountered problems while arranging a class in the school which we visited to perform the activity. There where teachers who did not want to give their course hour because they did not want to fall behind in their schedule. But we were able to perform the activity in a fifth grade class in the end by asking one of the teachers. (P11)"

Findings Related to The Opinions of The Participants About Gains Provided by Activities Developed in The "STM-II" Course for Middle School Students

Table 9. The gains provided by activities developed in the "STM-II" course according to prospective teachers

Themes	Categories	f
Group Work	To make classes more fun	21
	To increase the participation in class	14
	To ensure collaboration between students	13
	To enhance the communication between students	9
	To improve students' motivation	5
	To improve students' self-confidence	5
	To teach how to work in cooperation	4
	To create a sense of responsibility	4
	To enable students see their deficiencies	1
Discovery	To create an interest and curiosity toward mathematics	31
	To ensure permanent and meaningful learning	10
	To enhance the communication between students	9
	To improve students' self-confidence	5
	To have students discover mathematical concepts	4
	To allow students learn through brainstorming	2
	To offer different perspectives	2
	To raise a generation which produces information	1

Table 9. Continued

Themes	Categories	f
Problem Solving	To eliminate prejudices about mathematics	17
	To ensure permanent and meaningful learning	10
	To improve students' problem-solving skills	7
	To help students associate mathematics with everyday life	5
	To teach students problem-solving steps	4
	To ensure students review subjects	2
	To have students use tangible materials	1
Multiple Intelligences	To eliminate prejudices about mathematics	17
	To offer different perspectives	2
	To allow students to see their skills in different fields	2
	To help students get to know themselves better	1
Rule Teaching	To help students realize the importance of mathematical thinking	4
	To have students discover mathematical concepts	4
	To help students concretize abstract expressions	3
	To help students establish connections between concepts	2
	To teach students how to perform mathematical operations	1
	To teach students make proper use of mathematics	1
	To enhance students' learning	1
Computer-assisted Mathematics	To enable students think analytically	2
	To ensure individual learning takes place	2
	To allow students to learn a lot in a short time	1
	To introduce different mathematical softwares	1
	To teach students make better use of technology	1

Some of the participant opinions regarding "Discovery-Group Work-Multiple Intelligences-Problem-solving-Rule Teaching-Computer-assisted Mathematics" themes given in Table 9 can be found below.

"It increased students' interest in mathematics. (P5)"

"I can say that it made mathematics more enjoyable for students. (P31)"

"We tried to prevent students from approaching mathematics with prejudice. (P10)"

"I have found the opportunity to observe students actively participate in the class. (P23)"

"The purpose of the group work activity is to have students support each other's learning in small groups. (P17)"

"Students engaged in a more meaningful and permanent learning. (P28)"

Findings Related to The Gains Provided by Activities Developed in The "STM-II" Course for Prospective Teachers

Table 10. The gains provided by activities developed in the "STM-II" course for the participants

Themes	Categories	f
Professional Development	To learn how to communicate with students	11
	To learn how to make mathematics classes more interesting	9
	To gain experience about how to manage the class	9
	To gain professional experience	4
	To understand how to associate mathematics classes with everyday life	3
	To understand the importance of group work	1
	To understand the duties of the teacher	1
	To learn how to add new dimensions to the course by teaching mathematics with different methods	1
	To adopt different teaching methods	1
	To understand how to treat students based on their interests and abilities	1
	To understand the importance of the level of the class for applications	1

Table 10. Continued

Themes	Categories	f
Personal Development	To realize their lack of knowledge in certain subjects	6
	To be more curious	6
	To better understand the value of teaching	1

Some of the participant opinions regarding codes derived from "Professional Development" and "Personal Development" themes given in Table 10 can be found below.

"It is very difficult to communicate with students. Because I do not have any professional experience. I can say that these activities allowed me to gain experience in this sense. (P5)"

"I have learned how to make mathematics teaching more engaging first hand. (P9)"

"We have also decided to review our class management and focus on our shortcomings. (P1)"

Discussion and Conclusion

This study focused on the difficulties encountered by prospective mathematics teachers while carrying out activities, the opinions of prospective teachers about what middle school students gained from the activities and about what participants gained from the activities. Thus, an attempt was made to reveal the opinions of prospective teachers regarding the benefits achieved through and problems countered during the application of activities related to multiple intelligences, discovery, group work, problem-solving, the history of mathematics, mathematical rules and computer-assisted teaching.

Regarding difficulties encountered by the participants during the application process of mathematical activities, the participants mostly mentioned that it was time-consuming to prepare worksheets, it was difficult to find a school to perform the activity and students were reluctant toward the activity. Some of the findings obtained from "Prospective Teacher", "Student", "Time" and "School" themes show similarities with some studies in the literature (Bal, 2008; Ozpolat, Sezer, Isgor & Sezer, 2007). This shows that students and teachers are not accustomed to carry out mathematics classes with activities.

Regarding gains of "Discovery-Group Work-Multiple Intelligences-Problem-solving-Rule Teaching-Computer-assisted Mathematics" activities for students, the participants expressed that students had increased interest and curiosity in mathematics, classes became more enjoyable, prejudices toward mathematics were eliminated, participation in class increased, students helped each other more and permanent and meaningful learning was ensured. These findings are consistent with those of Elbers (2003) who reported that activities encouraged students to study and discover mathematical learning processes, allowed them to gain experience and develop new strategies. In addition, these findings show parallelism with those obtained by Yildiz and Baki (2016a, 2016b) in their study on the history of mathematics education. This leads to the idea that the activities developed greatly contributed to both cognitive and affective skills of the prospective teachers.

Regarding gains of the participants related to "Professional and Personal Development", it was revealed that the prospective teachers learned how to make mathematics classes more interesting, gained experience about how to manage the class and realized their lack of knowledge about certain subjects. In this context, Bozkurt (2012) found how perceptions of participants regarding the activity are reflected on the application to be a remarkable situation. These findings are consistent with the findings of the study. From this point, we can say that the activities allowed the prospective teachers to gain preliminary experience related to teaching.

Almost all of the participants included in the study expressed that the activities which they developed in the "STM-II" course and applied to middle school students improved their beliefs and confidence in their ability to teach mathematics. Thanks to this course, the prospective teachers found the opportunity to come out to the field outside the faculty environment and perform the activities. The prospective teachers stated that they believed these activities which they performed with students contributed a lot to their social-emotional and professional skills as well as their cognitive skills. The participants better understood the importance of the teaching profession thanks to beneficial learning processes which took place as a result of the activities. From this, we may conclude that the course helped the participants become prospective teachers who experienced the excitement and joy of teaching students mathematics through various activities. A literature review reveals that there are numerous studies conducted with the idea that developing activities will contribute to mathematics education and therefore teacher education (Herbst, 2008; Kerpic, 2011; Ozmantar,

Bozkurt, Demir, Bingolbali & Acil, 2010; Ugurel, Bukova-Guzel, 2010). Therefore, the findings of the study show that the activities have positive reflections on teacher training.

The participants made the necessary research using the curriculum, textbooks and various studies in the literature under the guidance of the researcher in the activity development stage and therefore were well-prepared and placed the necessary importance and value to the activities, which ensured that the activities were beneficial and effective. Similarly, Ersoy (2006) found that teachers' high level of knowledge, increased awareness and sensitivity toward their duties allowed activities to be beneficial and effective.

Considering the importance of guidance offered by the teachers and clues provided on how to learn in activities performed with primary school students, the importance of in-class activities is better understood (Ozmantar et al., 2010). In this context, students who perform or are encouraged to perform activities within the scope of in-class applications will become individuals who are accustomed to activities, able to understand the purpose of activities (Saglik, 2007; Yalvac, 2010) and eager to perform activities. Therefore, students will see that mathematics is actually an engaging course and it is possible to enjoy mathematics if they crack the secret of it as they perform activities. From this point, it seems that activities are effective in enabling students to view mathematics as an engaging course rather than a scary one and like mathematics better, understand the importance of cooperation and collaboration in group works (Baki et al., 2010), understand mathematics better and enhance their cognitive and social-emotional development. In this context, students should be encouraged to find their own solutions and make generalizations from their solutions while performing activities (Olkun & Toluk, 2003).

Researchers concluded that activities in almost all mathematics textbooks undervalued efficient use of time and pre-conditioned behaviors of students and did not include activities related to use of computer technologies other than the calculator (Arslan & Ozpinar, 2009; Kerpic & Bozkurt, 2011). Similarly, the results of the trends in international mathematics and science study indicate that activities developed and performed in the process are not implemented efficiently (Sisman, Acat, Aypay & Karadag, 2011). These results contrast with the findings of the study. Because the results of the study show that the activities were quite effective.

It was concluded that the "STM-II" course allowed prospective teachers to think mathematically (Arslan & Yildiz, 2010; Yildiz, 2016), solve problems (Taskin, Yildiz, Kanbolat & Baki, 2013), learn by doing and experiencing, reason, make connections and achieve permanent learning when learning concepts through activities developed and performed within the scope of the course. In addition to the cognitive dimension mentioned above, considering the affective dimension; the activities improved prospective teachers' belief and self-confidence, their ability to communicate with students and teachers at the school, their class management skills, their ability to cooperate with students and their sense of responsibility and allowed them to feel themselves as teachers.

The following recommendations are presented considering the results of the study:

1. The participants stated that they had difficulties in finding a school to perform the activities. Teachers and administrators serving in middle schools may try to help prospective teachers who will soon be in service to solve this problem. Also, considering that activities have an important place in student achievement in mathematics, the awareness level of teachers may be increased on this matter.

2. Some participants expressed that students were reluctant to perform the activities. It may be beneficial that teachers perform activities, especially those included in the 2009 curriculum and textbooks, more frequently in their classes and ensure students get accustomed to perform activities to overcome or reduce this problem. Also, learning-teaching activities in the 2013 curriculum may be enriched. In-service trainings may be organized to provide teachers with adequate knowledge and skills regarding activities included in the middle school mathematics curriculum in order to improve the situation.

3. The participants expressed that students had increased interest and curiosity in mathematics, classes became more enjoyable, prejudices toward mathematics were eliminated, participation in class increased, students helped each other more and permanent and meaningful learning was ensured. Considering the interest of students in the activities, teachers and prospective teachers may be informed about mathematics teaching through activities. Thus, the increase in the interest of students in mathematics will be sustainable.

4. Almost all of the participants included in the study expressed that the activities which they developed in the "STM-II" course and applied to middle school students improved their beliefs and confidence in their ability to teach mathematics. In all major field courses received by prospective teachers at undergraduate level, prospective teachers may be given the opportunity to develop activities with more tangible, clear and rich material support in order to achieve goals specified in the curriculum.

5. Interviews may be held with prospective teachers to investigate participant opinions about how to improve and apply activities in more depth. Also, observations may be conducted in order to examine how teachers develop activities and perform them in their classes and reveal difficulties which they encounter.

To summarize, it is recommended that mathematical activities are given more weight in schools, students are familiarized with activities and raise the awareness of teachers and prospective teachers regarding mathematical activities. Activities in the updated curriculum and textbooks may be enriched in a way that all mathematical gains from primary education level to secondary education level are emphasized.

References

Ainley, J., Pratt, D., & Hansen, A. (2006). Connecting engagement and focus in pedagogic task design. *British Educational Research Journal*, *32*(1), 23-38.

Arslan, S., & Ozpinar, I. (2009). Evaluation of 6th grade mathematics textbooks along with the teacher opinions. *Dicle University Journal of Ziya Gokalp Education Faculty*, 12, 97-113.

Arslan, S., & Yildiz, C. (2010). Reflections from the Experiences of 11th graders during the stages of mathematical thinking. *Education and Science*, *35*(156), 17-31.

Baki, A., & Gokcek, T. (2005). Comparison of the development of elementary mathematics curriculum studies in Turkey an the U.S.A. *Educational Sciences: Theory & Practice*, *5*(2), 587-588.

Baki, A., Gurbuz R., Unal, S., & Atasoy, E. (2009). The effect of activities based on multiple intelligences theory on learning: the example of four operations with whole numbers, *The Journal of Turkish Educational Sciences,* 7(2), 237-259.

Baki, A. (2008). *Mathematics education: Theory and Practice* (4th Edition). Ankara: Harf Egitim Publication.

Bal, A. P. (2008). The evaluation of new mathematic curriculum in term of teachers' Perspectives. C*ukurova University Journal of Social Sciences Institute, 17*(1), 53-68.

Bozkurt, A. (2012). Mathematics teachers' perceptions of mathematical activities. *Education and Science, 37*(166), 101-115.

Bransford, J. D., Brown, A. L., & Cocking, R. R. (Eds.). (2000). *How people learn: Brain, mind, experience, and school.* Washington, DC: National Academy Press.

Bukova-Guzel, E., & Alkan, H. (2005). Evaluating pilot study of reconstructed Turkish elementary school curriculum. *Educational Sciences: Theory & Practice*, *5*(2), 385-420.

Bulut, I. (2008). Teacher views on student-centered practices in the new primary education curriculum. *Educational Administration: Theory and Practice*, *56,* 521-546.

Connolly, T., Arkes, H., & Hammond, K. (2000). *Judgment and decision making: An interdisciplinary reader* (2nd Ed.). Cambridge University Press.

Council of Higher Education [CoHE]. (2007). Council of higher education. faculty of education, teacher training undergraduate programs.

Creswell, J. W. (2007). Qualitative inquiry and Research design. Choosing among five approaches. (Second Edition).Thousand Oaks, CA: SAGE Publications.

Doolittle, P. E. (2002). Complex constructivism: A theoretical model of complexity and cognition. Downloaded from http://edpsychserver.ed.vt.edu/research/complex1.html on 12.01.2003.

Dreyfus, T., & Tsamir, P. (2004). Ben's consolidation of knowledge structures about infinite sets. *Journal of Mathematical Behavior*, *23*(3), 271-300.

Duru, A., & Korkmaz, H. (2010). Teachers' views about a new mathematics curriculum and difficulties encountering curriculum change. *Hacettepe University Journal of Education, 38,* 67-81.

Ekiz, D. (2013). Scientific research methods. (Extended 3rd edition). Ankara: Ani Publication.

Elbers, E. (2003). Classroom interaction as reflection: Learning and teaching mathematics in acommunity of inquiry. *Educational Studies in Mathematics*, *54,* 77-99.

Epstein, M., & Tricia, R. (2002). *Constructivism.* Downloaded from http://tiger.towson.edu/~mepste1/researchpaper on 04.05.2003.

Eraslan, A. (2011). Prospective Elementary Mathematics Teachers' Perceptions on Model. Eliciting Activities and their Effects on Mathematics Learning. *Elementary Education Online, 10*(1), 364-377.

Ersoy, Y. (2006). Innovations in Mathematics Curricula of Elementary Schools-I: Objective, Content and Acquisition. *Elementary Education Online*, *5*(1), 30-44.

Fidan, Y. (2009). *the geometric thinking levels of primary grade 5 students and the effect of geometry teaching with discovery learning on geometric thinking levels of students,* (Unpublished Master's Thesis), Dokuz Eylul University, Izmir.

Gomleksiz, M. N. (2005). An assessment of the implementation of new science and technology curriculum. *Educational Sciences: Theory & Practice*, *5*(2), 339-384.

Henningsen, M., & Stein, M. K. (1997). Mathematical tasks and student cognition: Classroom-based factors that support and inhibit high-level mathematical thinking and reasoning. *Journal for Research in Mathematics Education, 28*(5), 524-549.

Herbst, P. (2008). *The teacher and the task.* Proceedings of the 32nd Annual Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education (Vol. 1, pp. 125-131). Morelia, Michoacán, Mexico.

Horoks, J., & Robert, A. (2007). Task designed to highlight task-activity relationships. *Journal of* Mathematics *Teacher Education*, *10,* 279-287.

Jones, I., & Pratt, D. (2006). Connecting the equals sign. *International Journal Computer Mathematics Learning*, *11,* 301-325.

Kayaaslan, A. (2006). *Believes of 4th and 5th grade students about the nature of mathematics and mathematics teaching, (*Unpublished Master's Thesis), Gazi University, Ankara.

Kerpic, A., & Bozkurt, A. (2011). An evaluation of the 7th grade mathematics textbook tasks within the framework of principles of task design. *Mustafa Kemal University Journal of Social Sciences Institute*, *8*(16), 303-318.

Ministry of National Education [MNE]. (2009). *Teaching Syllabus and Curriculum Guidebook for Elementary School Mathematics Course: Grades 6 to 8.* Ankara: MNE Turkish Education Board.

Ministry of National Education [MNE]. (2005a). *Teaching Syllabus and Curriculum Guidebook for Elementary School Mathematics Course: Grades 6 to 8.* Ankara: MNE Turkish Education Board.

Ministry of National Education [MNE]. (2005b). *Teaching Syllabus and Curriculum Guidebook for Secondary School Mathematics: Grades 9 to 12.* Ankara: MNE Turkish Education Board.

Ministry of National Education [MNE]. (2013). *Teaching Syllabus and Curriculum Guidebook for Elementary School Mathematics Course: Grades 5 to 8.* Ankara: MNE Turkish Education Board.

Ministry of National Education [MNE]. (2013). *Teaching Syllabus and Curriculum Guidebook for Secondary School Mathematics Course: Grades 9, 10, 11 and 12 - 4 hours per week) and Teaching Syllabus and Curriculum Guidebook for Secondary School Mathematics Course: Grades 10, 11 and 12 - 2 hours per week.* Ankara: MNE Turkish Education Board.

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

Olkun, S., & Toluk, Z. (2003). *Activity-based mathematics teaching in elementary education.* Ankara: Ani Publication.

Orton, A., & Frobisher, L. (1996). Insights into teaching mathematics. London: Cassell Wellington House.

Ozmantar, M. F., & Bingolbali, E. (2009). In Task design and basic design principles. Bingolbali, E., Ozmantar, M.F. (Ed), *Mathematical difficulties encountered in elementary education and suggested solutions.* Ankara: Pegem Academy.

Ozmantar, M. F., Bozkurt, A, Demir, S., Bingolbali, E., & Acil E. (2010). Perceptions of form teachers related to the concept of task. *Selcuk University Ahmet Kelesoglu Education Faculty Journal*, *30,* 379-398.

Ozpolat, A. R., Sezer, F., Isgor, I. Y., & Sezer, M. (2007). Investigation of form teachers' opinions on the elementary school curriculum. *National Education Journal*, *174,* 206-213.

Saglik, N. (2007). *Effects of activities based on the elementary education curriculum in pilot application phase on teaching of certain geometry subjects (*Unpublished Master's Thesis), Yuzuncu Yil University, Van.

Saunders, W. L. (1992). The constructivist perspective: Implications and teaching strategies for science. *School Science Mathematics*, *92*(3), 136-141.

Simon, M., & Tzur, R. (2004). Explicating the role of mathematical tasks in conceptual learning: An elaboration of the hypothetical learning trajectory. *Mathematical Thinking and Learning,* 6, 91-104.

Swan, M. (2007). The impact of the task-based professional development on teachers' practices and beliefs: A design research study. *Journal of Mathematics Teacher Education*, *10,* 217-237.

Sisman, M., Acat, M. B., Aypay, A., & Karadag, E. (2011). *TIMMS 2007 National Mathematics and Science Report: 8th Grade.* Ankara: MNE Turkish Education Board.

Taskin, D., Yildiz, C., Kanbolat, O., & Baki, A. (2013). Reflections of problem solving environment based on group work: Example of fibonacci problem. *Mediterranean Journal of Educational Research, 14a,* 170-175.

Watson, A. (2008). *Task transformation is the teacher's responsibility.* Proceedings of the 32nd Annual Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education (Vol. 1, 147-153). Morelia, Michoacán, Mexico.

Wellington, J. (2000). *Educational research, contemporary issues and practical approaches.* London: Continuum.

Yalvac, E. (2010). *Effects of activities included in the mathematics curriculum at the second stage of primary school on teaching of certain algebra subjects, (*Unpublished Master's Thesis), Yuzuncu Yil University, Van.

Yeo, J. B. W. (2007). *Mathematical tasks: Clarification, classification and choice of suitable tasks for different types of learning and assessment.* Technical report me2007-01, mathematics and mathematics education national institute of education, Singapore.

Yildirim, A., & Simsek, H. (2011). *Qualitative research methods in social sciences.* Ankara: Seckin Publication.

Yildiz, C. (2016). *Comparing the mathematical thinking experiences of students at faculty of education and faculty of arts and sciences.* International Conference on New Horizons in Education (INTE-2016), Vienna University of Technology, Vienna, Austria.

Yildiz, C., & Baki, A. (2016a). Teachers' views about factors which affect history of mathematics usage in lesson. *Ahi Evran University, Journal of Kirsehir Education Faculty, 17*(2), 451-472.

Yildiz, C., & Baki, A. (2016b). Opinions of teachers on life stories of ancient mathematicians and teachers' situation of including those stories in classes. *Karadeniz, 31,* 43-62.