EFFECTS OF HISTORY OF MATHEMATICS INTEGRATED INSTRUCTION ON MATHEMATICS SELF-EFFICACY AND ACHIEVEMENT

by
Özlem Albayrak
B.S., Primary Mathematics Education, Boğaziçi University, 2008

Submitted to the Institute for Graduate Studies in
Science and Engineering in partial fulfillment of
the requirement for the degree of
Master of Science

Graduate Program in Secondary School Science and Mathematics Education
Boğaziçi University
2011

EFFECTS OF HISTORY OF MATHEMATICS INTEGRATED INSTRUCTION ON MATHEMATICS SELF-EFFICACY AND ACHIEVEMENT

APPROVED BY:

Assoc. Prof. Ayşenur Yontar -Toğrol ……………………
(Thesis Supervisor)

Assoc. Prof. Emine Erktin ……………………

Assist. Prof. Zeynep Çiğdem Özcan ……………………

DATE OF APPROVAL: 05.05.2011

ACKNOWLEDGEMENTS

I would like to thank several people whose guidance and support were priceless in the preparation and completion of this thesis. First, I would like to express my sincere appreciation to my supervisor, Assoc. Prof. Ayşenur Yontar Toğrol, for her constant encouragement, her patience, inspiration and assurance at the difficult times of this study. In every step of my study I felt how much lucky I am as being her student. She believes me even in my hopeless times about the completion of this study.

I am also thankful to the members of the supervisory committee, Assoc. Prof. Emine Erktin and Assist. Prof. Zeynep Çiğdem Özcan for their knowledge and assistance. I really benefited from their feedback in shaping my study. In addition, I want to thank to Dr. Fatma Aslan Tutak with her important contributions and valuable assistance especially in preparing my instruments and lesson plans.

I wish to thank the students who participated in this study and their mathematics teachers Olcay and Aylin, for thier support and cooperation.

Thank to "TUBİTAK-Bilim İnsanı Destekleme Programı" for their financial support throughout my research study.

My dear friends, Mehtap, Bilge, I feel your love and encouragement every time. Thank them for being with me when I needed. I express thanks also to my collague for editing my thesis. With the help of her, my thesis has better English.

My family, my mother Aynur Albayrak; my father Haşim Albayrak and my sister Öznur Albayrak… I wish to express my deep graduate to my family for their unlimited love, support, understanding and encouragement in this endeavor. Thanks for trusting me and encouraging me to pursue my goals. I could not express how much I appreciate that they have done for me so far. Without their constant support, I would never have achieved this honor.

Finally, my deepest thanks go to my husband, Mehmet Fatih Kacır. He tolerated a great deal of neglect by me while I was working to fulfill the requirements for this degree even in the new days of our marriage. Thanks for your love, patience and encouragement not only for this study but also in every part of my life.

ABSTRACT

EFFECTS OF HISTORY OF MATHEMATICS INTEGRATED INSTRUCTION ON MATHEMATICS SELF-EFFICACY AND ACHIEVEMENT

This study was conducted to develop an instruction integrated with history of mathematics on volume of pyramids, cone and sphere topics; and to implement it with an experimental design in order to measure the effectiveness of this instruction on mathematics self-efficacy and achievement.

The instruction was developed after precise consideration of the suggestions and cautions raised in the literature and its effectiveness was determined by a quasi-experimental design. The implementation of the instruction was carried out in two public schools in İstanbul with participation of 131 eight grade students. Both quantitative and qualitative data were gathered.

Data gathered from the sample were analyzed on the purpose of examining the changes in students' mathematics achievement levels, self-efficacy toward mathematics and their views on history of mathematics integrated instructions. Paired sample t-test was used for analysis of data obtained from both regular and experimental groups in two schools indicated that there were significant differences between the pretest (Pretest Volume-Part3) and posttest (Posttest Volume-Part2) scores of students in terms of their mathematics achievements. Independent sample t-test was used for analysis of data if there was a significant effect of type of instruction on mathematics achievement levels of control and experimental groups in both schools. Results display that there was a significant difference on posttest scores of experimental and control group students only in one school. Namely it means that in one of the treatment schools, students' achievement levels in experimental group were significantly higher than the control group students in posttest which assess their achievement in treatment topics. Also, paired sample t-test pointed that both types of instructions were not effective in providing a significant development over the mean values between the pre and posttest levels of students in Mathematics Self-efficacy Scale, and, independent sample t-test indicated that there was not any significant difference on posttest scores of the experimental and control group students in both schools. The results attained from qualitative data showed that experimental group students generally had favorable declarations about history of mathematics integrated instructions.

ÖZET

MATEMATİK TARİHİYLE İŞLENMİŞ OLAN DERSLERİN MATEMATİK ÖZYETERLİK ALGISINA VE MATEMATİK BAŞARISINA ETKİSİ

Bu çalışma; piramitlerin, koninin ve kürenin hacmi konusunda matematik tarihiyle harmanlanmış bir öğretim tasarımı gerçekleştirmek ve bu tasarımın matematik öz yeterlik algısı ve başarısı üzerindeki etkilerini deneysel bir desenle ölçmek amacıyla yürütülmüştür.

Öğretim uygulaması, literatürdeki öneri ve uyarılar temel alınarak geliştirilmiş ve etkililiği yarı deneysel araştırma deseniyle belirlenmiştir. Öğretim tasarımının uygulanması İstanbul ilindeki iki devlet okulundan 131 sekizinci sınıf öğrencisinin katılımıyla yürütülmüstür. Nicel ve nitel veriler toplanmıştır.

Örneklemden toplanan veriler öğrencilerin matematik başarı seviyelerindeki, matematik özyeterlik algılarındaki ve matematik tarihiyle harmanlanmış derslerle ilgili görüşlerindeki değişimi belirlemek amacıyla analiz edilmiştir. Her iki okuldaki deney ve kontrol gruplarından toplanan verilerin analizinde kullanılan eşli örneklem t-testi analizi, öğrencilerin matematik başarısı açısından ön test ve son testleri arasında anlamlı bir fark olduğunu göstermiştir. Verilerin analizinde, her iki okuldaki kontrol ve deney gruplarının matematik başarı seviyeleri üzerinde öğretim farklılığının anlamlı bir etkisinin olup olmadığını göstermek için bağımsız örneklem t-testi kullanılmıştır. Yalnızca bir okulda, deney ve kontrol grubunun son test sonuçları arasında anlamlı bir fark olduğu görülmüştür. Yani, uygulama okullarından birinde öğrencilerin uygulama konusundaki başarı seviyelerini ölçen son testte, deney grubundaki öğrencilerin başarı seviyeleri kontrol grubundaki öğrencilerin başarı seviyelerinden anlamlı olarak yüksektir. Ayrıca, eşli örneklem t-testi, her iki tür öğretiminin de öğrencilerin Matematik Öz yeterlik Algısı Ölçeğinde ön test ve son test seviyelerinin ortalamalarında anlamlı bir gelişme sağlamada etkili olmadığını göstermiştir. Bağımsız örneklem t-testi her iki okuldaki deney ve kontrol grubu öğrencilerinin son test sonuçlarında matematik öz yeterlik algısı açısından anlamlı

bir fark olmadığını göstermiştir. Nitel veri sonuçları, deney grubu öğrencilerinin matematik tarihiyle harmanlanmış dersler hakkında genellikle olumlu bildirimlerde bulunduğunu göstermiştir.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF SYMBOLS

df	Degree of freedom
f	Frequency
M	Mean
n	Number
Sig.	Significance
Std. Deviation	Standard Deviation

LIST OF ACRONYMS / ABBREVIATIONS

TVpre-Part1	Test- Volume – pre - Part1
TVpre-Part2	Test- Volume – pre - Part2
TVpre-Part3	Test- Volume – pre - Part3
TVpost-Part1	Test- Volume – post - Part1
TVpost-Part2	Test- Volume – post - Part2

1. INTRODUCTION

Scientific and technologic improvements and rapid increase in global knowledge accumulation in the last decades obligate human beings and societies to be commited to education. Education calls for an increased emphasis on people's renewing themselves, thinking creatively, making discoveries and inquiries in learning. In other words, education provides putting one's potentials to maximum use. Through the attainment of education, man is enabled to receive information from the external world; to acquaint him with past history and receive all necessary information regarding the present. Looking from this sense, qualified mathematics education is one of the touchstones in education. Its significance to education is not limited to the following aspects. Mathematics is more than just the science of numbers taught by teachers in schools and either enjoyed or feared by many students. It plays a significant role in the lives of individuals and the world of society as a whole. Mathematics is an essential discipline recognized worldwide, and it needs to be grown in education to equip students with skills necessary for achieving higher education, career aspirations, and for attaining personal fulfillment. According to MEB (2009), in our changing world, people who understand and do mathematics have more options in shaping the future.

Although the importance of mathematics education becomes clearer, mathematics has been seen as complex and abstract by many students. They could also create some negative feelings toward mathematics which affect their success in mathematics (Elçi, 2002; Fuson, Karlhman and Brandsford, 2005; İdikut, 2007). Contrary to other disciplines, mathematics is seen as abstract and not related with life and by this way, it creates discomfort with students. However, mathematics has always been at the heart of education throughout the history (National Research Council, 2001). Due to its important missions, teaching and learning processes should be designed in such a way that students could reduce their mathematics phobias and understand that mathematics facilitates their lives. Therefore, mathematics education should be created in an environment where children are eager to seek knowledge and learn new things. It should help students make mathematical concepts more meaningful and interesting, so that they could feel that mathematics is not an isolated discipline (Carter, 2006).

In order to attain these aims, one of the important ways of increasing students' awareness and interest for mathematics may be putting mathematics instructions integrated with history of mathematics. In recent years, there has been growing interest in the role of history of mathematics in improving the teaching and learning of mathematics. By learning the history of the related mathematics topics, students may have an understanding of how the important developments came about. They may see that mathematics was created by human beings as a result of their needs and also be more eager to learn it because the history of mathematics reveals long traditions, different cultures, peoples' emotions and development. Moreover, it may help students learn the origin of mathematics and the reasons why they learn mathematics. Several studies (Awosanya, 2001; Carter, 2006; Goodwin, 2007; İdikut, 2007; Liu, 2003; Marshall, 2000; Sassano, 1999; Tözlüyurt, 2008) also support the use of the history of mathematics integrated into mathematics lessons to enhance the interests, attitudes or achievement of the students.

Current mathematics curriculum in Turkey (2005) emphasizes some goals which could increase the success of mathematics education. One of the goals concerns the use of history of mathematics (MEB, 2009). It aims to make students understand the historical progress of mathematics as well as historical progress of the human mind. By this way, students may see the whole picture of mathematics and also the position of mathematics in their life. They may deepen their understanding of mathematics. Another goal is to increase students' positive attitudes toward mathematics and help them have self-confidence.

In the light of these goals of mathematics curriculum, the researcher intends to design a mathematics instruction integrated with history of mathematics in order to have a positive effect on students' mathematics self-efficacy and their achievement on mathematics. Thus, this study aims to examine the effects of instruction integrated with history of mathematics in a selected mathematics topic, namely volume of pyramid, cone and sphere, on 8th grade students' mathematics self-efficacy and achievement.

2. LITERATURE REVIEW

As an overall trend, the literature review begins with defining the construct self-efficacy towards mathematics and stating its effects in education. Then, it continues with an overview on history of mathematics in order to give a general view about the evolutionary nature of mathematics. The review proceeds with a framework about the role of the history of mathematics for how and why to integrate it in teaching and learning process. After that, studies on the history of mathematics will be stated which will guide this study and shape the design and procedure of it. The review ends with information about the history of mathematics in Turkish curriculum. The instructions in this study will be prepared based upon the inferences gained from the literature. So he literature review includes three parts which can be sorted as *i) mathematics self-efficacy, ii) the role of history of mathematics in mathematics education, iii) studies on the history of mathematics.*

2.1. Mathematics Self-efficacy

The literature review on self-efficacy toward mathematics indicated the works that reveal what self-efficacy and mathematics self-efficacy refer to and their effects on students' attitudes and mathematics achievement. Also, some research studies have revealed that self-efficacy correlates positively with mathematics attitudes (Michaelides, 2008).

Students' ability to learn mathematics has been the concern of researchers for many years. One of the factors that affect the success in mathematics education in a positive or negative way is self-efficacy toward mathematics. Why are some students willing to learn and ready to cope with challenges with high confidence while others appears unconcerned or unsure? Theories about self-efficacy try to give answer to these questions. Amy and his colleagues (2006) state that, self-beliefs are a critical part of most modern theories about human motivation.

The construct self-efficacy was introduced firstly by Bandura (1977) in his social cognitive theory in the late 1970s. Perceived self-efficacy is related with people's beliefs in their ability to influence events in their lives (Bandura, 1997). It could be defined as an individual’s “I can” or “I can not” belief. People who have high self-efficacy beliefs put themselves challenging goals and continue to struggle over against failure and increase the likelihood of success in achieving the expected goals. Conversely, people who have low self-efficacy keep away from difficult goals and could not focus attention on how to handle difficulties. Also, according to Kiremit (2006), people who have not enough self-efficacy think that the problems they should cope with are very difficult than they really are and they evaluate the events with limited viewpoints. On the other hand, people with high self-efficacy feel more relaxed and confident even in difficult jobs. Peoples’ beliefs related with individual capability generally affect the outcomes before the actions occur.

Snyder and Lopez (2002) stated that self-efficacy is what people can do with their skills under certain conditions; in other words self-efficacy beliefs are beliefs about what one can capable of doing. Gaskill and Woolfolk (2002) argue that self-efficacy is different from other conceptions of self because it involves judgments about capabilities specific to a particular task. Self-efficacy is not intention, self-esteem, motive, drive, or need for control. Self-efficacy which refers to an individual’s judgment about being able to carry out a particular activity could be considered also one of the motivational constructs. Self-efficacy beliefs motivate students’ learning through use of self-regulatory processes such as goal setting, self-monitoring, self-evaluation, and strategy use (Zimmerman, 2002). Self-efficacy construct is considered effective in predicting students' motivation, learning and academic achievement. Self efficacy is concerned with adults’ and children’s beliefs about their ability to perform a task and exerts a powerful influence over their motivation for that task. Hence, the self-efficacy construct is an important predictor of behavior.

According to Bandura (1997), self-efficacy judgments are based on four sources of information: mastery experiences, vicarious experiences, social persuasion, and physiological and emotional states. The self-efficacy sources has important contributions in determining of how individuals make choice, expend effort to achieve goals, and continue to complete of these goals (Zarch and Kadivar, 2006)

Bandura (1997) claimed that *mastery experience* which could be defined as one's own TVpreious attainments is the most effective way in contributing a strong sense of efficacy to students' achievement. If students succeed at a particular task in the past, they most likely would believe that they could be successful at the task in the future also. This can be due to students' long term memory for their success or failure. The second source of self-efficacy is *vicarious experiences* which mean observing people similar to one's performance at a task. Namely, seeing people similar to their success or failure creates a social model and people could easily evaluate their own abilities. *Social persuasion* is a third way of supporting peoples' beliefs about being successful. People who are persuaded by others that they own the required capabilities to perform the given tasks could be more successful. "You can do this!" message from teachers, parents or peers could bolster students' self confidence to do a task. Self-efficacy is also impacted by *emotional and physiological states* such as anxiety, stress, fatigue, and mood. Physiological excitations could be interpreted by students as signs that increase or decrease their confidence.

Usher and Pajares (2006) examine the influence of these four domains of Bandura - mastery experience, vicarious experience, social persuasions and physiological state- on self-efficacy in their study. Their findings supported the four principles of Bandura's social cognitive theory that is these sources influence both academic and self-regulation efficacy beliefs.

After giving the definition and sources of self-efficacy in general, mathematics self-efficacy can be mentioned specifically. It was defined by Betz and Hackett (1987) as the specific self-assessed belief in one's own capability of solving mathematical problems and tasks successfully. The findings of the study of Zarch and Kadivar (2006) supported that mathematics performance was mediated by mathematics self-efficacy as well as mathematics self-efficacy was affected by math-performance. It means that there is a reciprocal relationship. Self-efficacy, sources of self-efficacy, and emotional feedback were all stronger predictors of mathematics performance (Stevens, *et al.*, 2006).

Works on self-efficacy have been one of important interest topics of researchers since the last twenty years. Scholz and his colleagues (2002) state that self-referent thought has become an interesting subject matter that provides opportunities to make psychological research in many domains. Many studies show that mathematics performance is directly related with mathematics self-efficacy (Uzar, 2010). Students with high performance have higher self-efficacy levels than students with low mathematics performance. Similarly, it has been stated by Erktin and Ader (2004) that the belief of self-efficacy had significant influence on success in mathematics.

Pajares (1993) aimed in his study to discover whether individuals' self-efficacy beliefs play the predictive and mediational role on mathematics problem solving performance. Participants involved 350 university students. Data were analyzed by using path analysis which revealed the results that perceived self- efficacy was predictive of capability to solve mathematics problems than was mathematics self-concept, mathematics anxiety, mathematics outcome expectations, prior mathematics experience, or gender. Results of this study prove that students' self-efficacy beliefs are important predictors of performance and mediate the effects of other self beliefs on performance.

Nicalau and Philippou (2007) examined the relation among efficacy in problem posing, problem-posing ability, and mathematics achievement. Quantitative data were obtained from 176 fifth and sixth grade students, and also interview were made with six students selected on the basis of hierarchical cluster analysis. Perceived self-efficacy beliefs have been found to be a strong predictor of the respective mathematical performance as well as of the general mathematics achievement. Similar findings were obtained from the study of Chen (2002). He studied about the self-efficacy beliefs of 107 seventh-grade mathematics students, especially focusing on the accuracy and predictability of their beliefs. Results based on path analysis showed that self-efficacy played a direct role in predicting students' math performance, post performance self-evaluation, and post performance judgments of effort. The findings also indicated that self-efficacy is not related with gender differences. As a result, the findings supported self-efficacy predictions.

In another work about self-efficacy and mathematics performance, the aim of the study of Ayotola and Adedeji (2009) was to determine the relationship between mathematics self-efficacy and achievement in mathematics. The sample consists of 352 senior students. According to the results, teachers should use some strategies to increase students' mathematics self-efficacy and confidence in order to enhance success in mathematics achievement. In another study, five variables - math self-efficacy, math self concept, perceived usefulness of mathematic, math anxiety and gender - were examined for analyzing the predictor of math achievement (Kiamanesh *et al.*, 2004). Regression analysis and path analysis methods were used for checking data obtained from 400 subjects. The results indicated that math self-efficacy is a strong predictor of math achievement compared to math self-concept, perceived usefulness of mathematics and gender.

In the study of Zientek and Thompson (2010), self-efficacy and mathematics anxiety have been recognized as predictors of mathematics achievement. They made secondary analyses on matrix summaries available from prior published studies with an aim to explore the contribution that self-efficacy and mathematics anxiety made in mathematics performance. Data from four different studies with five samples consisting of students in Grades Six through college levels were investigated by using commonality analyses. The results showed that, mathematics self-efficacy consistently had effects on mathematics performance whereas mathematics anxiety did not have significant effects on mathematics performance.

In the study of Graham (2000), the aim was to determine the influence of various mathematics self-beliefs on mathematics performance, whether these self-beliefs change throughout the middle school years, and whether motivation and change in motivation vary by gender or by mathematics placement (gifted/regular education). The study took part over the course of three- year investigation of 207 participants. At the beginning and end of each academic year, motivation and performance were assessed for middle school students. Mathematics self-efficacy predicted mathematics performance at every time point except the grade eight. The strength of various motivation constructs decreased from start of grade six to end of grade eight. The decline in students' self-concept, value, and engagement points a general loss of spirit in mathematics area over the middle school years.

Zarch and Kadivar (2006) examined in their study the direct and indirect effects of mathematics ability, especially mathematics self-efficacy, on mathematics performance. The participants of the study consisted of 848 eight grade students. Confirmatory factor analysis used to analyze data verified that mathematics self-efficacy had a direct and indirect effect on mathematics performance. The findings were consistent with of Bandura's social cognitive theory about the effects of self-efficacy.

Usher (2009) took as basis the four sources of Bandura – mastery experience, vicarious experience, social persuasions, and physiological or affective states - and aimed to examine the heuristics students use as they form their mathematics self-efficacy from these and other sources. Semi-structured interviews were made with eight middle school students. According to the results; teaching structures, course placement, and students' self-regulated learning were emerged as important factors related to self-efficacy. Results support the tenets of social cognitive theory.

The study of Moore (2005) presents an example of the study in which the effects of constructivism and extensive interdependent group work on achievement, self-efficacy and motivation were analyzed. Quantitative and qualitative analysis of surveys and self-assessment indicated that student achievement, self-efficacy, intrinsic motivation, and group work skills in the middle-school mathematics classroom were positively affected.

On the other hand, the findings of some studies showed that the self-efficacy may not be significantly related with mathematics performance. For example, Fleming (1998) argues that the relationship between self-efficacy, gender, other motivational constructs and mathematics performance is not well established. So, he purposes in his study to use a structural modeling technique to evaluate these relationships. The participants consisted of 32 graduate students completed questionnaires regarding their self-efficacy, anxiety, self-concept and prior experiences in mathematics. They also completed a series of mathematics problems. Data were evaluated in an attempt to test Bandura's (1986) theory regarding the relationship among these constructs and to replicate the findings of Pajares and his colleagues. Results indicated that many of Bandura's hypotheses were not supported. Self-concept had more influences on performance than self-efficacy, and self-efficacy did not appear to mediate the influence of prior experience on performance, self-concept, or self-efficacy. Thus, many of the findings were different from those of Pajares and his colleagues.

In another study conducted by Migray (2002), relationships between sixth and seventh grade students' (N=651) mathematics self-efficacy, academic self-concept, and mathematics achievement were examined. Participants were required to complete the academic subscale of the Multidimensional Self Concept Scale, the self-efficacy rating form, and the math performance sheet. Results show moderate correlations between mathematics self-efficacy, academic self-concept, and mathematics achievement. Relationship between math achievement and math self-efficacy and academic self-concept differed by grade and ethnicity.

According to Bıkmaz (2004), in Turkey, studies about self-efficacy and mathematics performance have been started recently. Terzi and Mirasyedioğlu (2009) aimed in their study to determine the relation between students' perceived self-efficacy and their academic success, and examining the variables affecting their perceived mathematics self-efficacy. The Perceived Mathematics Self Efficacy Scale and Personal Information Form were implicated to 118 students from Department of Elementary Mathematics Teaching of Gazi University. Significant positive correlations (r=0.49) were obtained between students' perceived mathematics self-efficacy and their academic success.

The study was conducted by Uzar (2010) aimed to examine middle school students' mathematics self-efficacy and its sources (Mastery Experiences, Vicarious Experiences, Social Persuasions, Physiological and Affective States) in terms of gender, grade level, type of school, and mathematics achievement. Relational survey method was used for this study to 491 participants consisted of sixth, seventh, and eight grade students. Two scales were given to students to assess their mathematics self-efficacy and its sources. Results according to data which was analyzed through correlations, t-test, and one-way ANOVA showed that there were positive significant correlations between mathematics self efficacy and each source of efficacy. No significant differences were found between girls and boys in terms of self-efficacy. But, students' mathematics self-efficacy was significantly different in terms of school type and grade level. Similarly, higher achieved students showed higher self-efficacy compared to lower achieved students. Also, students with different levels of mathematics achievement were significantly different from each other in terms of all sources of efficacy.

In the study conducted by Aşık (2009), students' poor problem solving performance was investigated within a self-regulation framework. Motivational relation factor was one of the frameworks. Self-efficacy and effort were indicators of motivational regulation factor. The results demonstrated that motivational regulation had direct and indirect effects on problem solving performance.

In another study, Özyürek (2010) focused on the convergent and discriminate validity of the Mathematics Self-Efficacy Informative Sources Scale. 692 high school students constituted the participants of the study. Both explanatory and confirmatory factor analyses were conducted for the content of the scale. It was also examined that if the scale showed any differences in terms of gender or class level. Findings showed that class level and gender variables were not effective in explaining the variables informative resources. So, the researcher suggest to search students' mathematical background rather than focusing on gender and class level.

Mathematics self-efficacy appears to be relevant in terms of providing opportunities to understand students' behaviors more accurately. It is related with academic success. Since the literature indicates, the benefits of high self-efficacy, the instructions could be modified in a way to increase students' self-efficacy in mathematics.

2.2. The Role of the History of Mathematics in Mathematics Education

Mathematics is one of the oldest sciences of human history. People have studied, learned and used mathematics for over four thousand years. The history of mathematics became prominent as a result of the practical needs of human beings in their everyday life in early periods (Cooke, 1997). People use it to meet the needs in commercial computations, to understand the relationship between numbers, to make land surveying and to forecast the astronomical events (Tez, 2008). People became interested in for various reasons like aesthetic concerns, order, communication, technology, deduction, analysis, etc. Many researchers examined the history of mathematics and they made diverse classifications based on different frames of mind. However, common important periods of the history of mathematics in which several researchers agree with are as follows with some basic specific characteristics (Cooke, 1997; Davis and Hersh, 2002; Struik, 2002; Tez, 2008; Ülger, 2006):

i. *Beginning- Prehistoric Period:* In the prehistoric period, basic number, shape, time and astronomy concepts were developed. Improvements in commerce and art were also important in the development of a number concept in the early periods.

ii. *Ancient Eastern Mathematics:* Ancient Eastern mathematics had practical roots. Calendar calculations, agricultural production and tax collection procedures lead to the way for progress in arithmetic and measurement. In time, the knowledge on measurement leads to the emergence of a pure geometry. Ancient Eastern mathematics included the mathematics of Egypt, Mesopotamia, China and India.

iii. *Greek Mathematics:* The basic aim of Greek mathematics was to base mathematics on a reasonable ground. They used deductive method especially in geometry.

iv. *Islamic Period:* Mathematics of the Islamic World extending from Mongolia to Spain was built based on the mathematics of the Greek, Hindus and the Chinese. It acts as a link between the early and the modern mathematics.

v. *Western mathematics:* In the Western Christian world, during the Renaissance period; studies of the ancient Greeks and Romans were examined. The effects of the Renaissance such as scientific revolutions and colonial expansion and medieval universities increased the development of mathematics. In the seventeenth and eighteenth centuries, calculus was developed.

vi. *Modern mathematics:* After the development of the calculus, many new questions were asked leading mathematicians beyond calculus into the modern versions of mathematics.

This classification is important in order to give a general view of the evolutionary nature of mathematics and prove that mathematics was created and has been developed by human beings since the beginning of history. So, it may be helpful for students to learn the history of such an old science in order to increase their understanding of mathematical concepts, theorems, computations or etc.

The idea of utilizing the history of mathematics in mathematics education is not new, it has been applied since 1960s and 1970s (Fried, 2001). However, the history of mathematics has grown its important role in teaching and learning since the last two decades. In 1995, the Institute in the History of Mathematics and Its Use in Teaching (IHMT) was established and has been worked to support mathematics teaching with historical modules. Then, the meeting of the International Congress on Mathematics Education (ICME) in 1996 purposed to promote the use of the history of mathematics to instruct and motivate students and several papers were presented about it in mathematics education after this meeting (Marshall, 2000). Although the history of mathematics was given importance in the literature, little has been done, in practice, at schools in order to combine it with mathematics instructions. In the recent years, some important works on the relationship between the history and mathematics education have appeared. Many studies (Arcavi and Isoca, 2007; Awosanya, 2001; Cooke, 1997; Fried, 2007; Furinghetti, 2000; Grugnetti, 2000; Jankvist, 2009; Tzanakis and Arcavi, 2000) investigated the reason for using the history of mathematics and why this could be beneficial in mathematics education and also ways to use this in mathematics teaching and learning.

For the next move in this part of literature review, the role of history of mathematics will be examined in terms of its reasons to use it in mathematics education and also ways to use it in mathematics education.

2.2.1. The Reason for Using the History in Mathematics Education

Integrating the history of mathematics to teaching and learning process of mathematics is one of the various strategies that were devised to aid better understanding for students' learning. In this part, the suggestions of several writers about using the history in teaching and learning mathematics will be given in terms of the educational benefits.

In recent years, the history of mathematics has been given an increasing emphasis for developing teaching and learning quality of mathematics. ICMI (International Commission of Mathematics Education) was one of the organizations performed a study and attempted to make a point of the concerns in the area of the history of mathematics in education (Fauvel and Maanen, 1997).

The article of Jankvist (2009) which includes a discussion about "why" to use the history of mathematics in teaching and learning mathematics points out two kinds of arguments, namely *history as a tool* and *history as a goal*. The *history as a tool* argument supports the view that history could motivate students, and increase the interest and excitement for the subject. It could also render mathematics more humane. In addition to such motivational and affective effects, the history of mathematics could also have cognitive effects because it offers a different point of view. The other argument, as *history as a goal*, on the other hand, claims that the aim is to show students mathematics has existed and evolved over time and space, human beings have participated in this evolution, which took place through different cultures, and in turn affected the shape of mathematics. The history of mathematics serves a purpose in itself.

Grugnetti (2000) claims that if learning is not only an accumulation of items of knowledge, but also a set of critical attitudes about knowledge, then the question is not about the quantity of knowledge but about the quality thereof. Why has a certain concept arisen? Under which historical conditions has it arisen? In order to answer these questions, it can be looked at the traditional idea which supports a belief that the development of mathematics is purely cumulative. However, that idea is substantially out-of-date. According to von Glasersfeld (1991), teachers must remain aware of the inherent relativity of knowledge, and of the fact that, in the long run, providing students with an adequate view of how science builds up knowledge is more valuable than the mere acquisition of facts. Alternatively, Struik (2002) explains mathematics as the adventure of ideas. Therefore, history of mathematics reflects the ideas of many generations. It can be admitted that mathematics was affected by the cultural and social atmosphere of the period it evolved in.

Utilizing the history of mathematics in mathematics instructions may be effective both for teachers and students. Kleiner (1996) claimed that the history of mathematics attracts the attention of the teachers to the topics, assists them in teaching the importance of the subject; and also motivates the students to ask "why" and "how" questions. The history of mathematics provides a story of how mathematics developed, areas where it can be used or what kind of important problems were there in the past. Old texts also provide information about the ancient cultures and times. Swetz (2000) claimed that if these texts are investigated with the questions like what is this text attempting to teach or how is it doing it, in mind; the early mathematical pedagogy will arise.

Several writers listed the benefits of using history in mathematics lessons. Cooke (1997) stated that the mathematics of other societies could be studied for many reasons. He indicated some of them as follows:

- The creators of mathematics were exceptional geniuses whose creations deserve being remembered;
- Their alternative ways of looking into the problems make us review our own solutions;
- Some of what they did have become part of the world's mathematical heritage, and its history should be told;
- Some of the problems other cultures have studied have no parallel in our own culture and so, are delights to our imagination. (p.191)

Liu (2003) proposed five reasons for using the history of mathematics in mathematics lessons:

- History can help increase motivation and helps develop a positive attitude toward mathematics.
- Past obstacles in the development of mathematics can help explain what students find difficult today.
- Historical problems can help to develop students' mathematical thinking.
- History reveals the humanistic facets of mathematical knowledge.
- History gives teachers a guide for teaching. (p.416)

Awosanya (2001) stated some reasons for utilizing history in mathematics instructions:

- History helps to increase motivation for learning.
- It makes mathematics less frightening.
- Pupils derive comfort from knowing that they are not the only ones who find mathematics problems difficult, that is, that is many other students find mathematics difficult.
- It gives mathematics a human face- making mathematics appealing to study- associating mathematics with mathematicians of the past.
- It changes pupils' perception of mathematics as a dull subject to a more interesting one.
- History of mathematics provides less aversion to mathematical activities.
- Knowledge of efficient approaches to current topic could be learned.
- Realization that mathematicians are real people- it is not uncommon to spend a great deal of time on a single mathematical topic (p.7-8).

So, the lists of different researchers mentioned above about the reasons to integrate the history of mathematics to mathematics instructions have some common grounds like humanizing mathematics, increasing the interest toward mathematics and learning the alternative ways to solve the problems or activities. Some of the other reasons for introducing the history of mathematics into mathematics education comprise making mathematics more engaging and approachable for students, providing insights into mathematical problems, techniques, and concepts (Fried, 2007).

During the process of modeling and solving an old problem in history, students see the old ways and techniques of solving the problems. They might get some ideas from historical problems which could help to solve their own problems. They could also have the possibility to compare the old and new methods of solving the problems. In addition to that, problems from the history may be interesting for students, dealing with such historical problems may increase a sense that mathematics could be solved with simple tools and techniques together with human thought and initiative than mechanical application of several complicated methods and a high amount of information. So that, students could feel that they can do mathematics and their self-confidence could increase their belief in their own abilities as human beings (Savizi, 2006). Also, in mathematics classes, the materials from the history of mathematics designed with the purpose of learning to understand the other's perspective can be engaging and meaningful (Arcavi and Isoda, 2007).

Moreover, Furinghetti (2007) gives the fact that integrating the history of mathematics to mathematics instructions promotes cultural understanding. It also promotes a sense of replacement which means replacing the usual with something different, so students could see that mathematics is not only the collection of knowledge and techniques. The cultural understanding and replacement supported by the history helps to humanize mathematics education.

In active learning processes, the history of mathematics is the most naturally integrated in mathematics education (Yevdokimov, 2004). By drawing students' attention on the history of the mathematical substance, students' imagination would be absorbed in that time, from Ancient World to nowadays. What's more, students could analyze mathematical contents from today's point of view and perceive evolutionary development of mathematical concepts and different properties throughout the centuries. For example, Yedkimov (2006) stated that the history of mathematics is integrated with instruction in discovery-based learning. Such mathematical discoveries help students to enhance their understanding of different ideas and theories, to motivate them for further learning and also to indicate the richness of human activities in mathematics. Adding history to mathematics instructions shows to the learners the human effect in mathematics. Furthermore, it facilitates students' apprehension the "whys" by giving the logical development (Bidwell, 1993).

Georgiou (2006) explained that multicultural education is an interesting approach in teaching and learning mathematics. The history of mathematics is one of the vehicles by which multicultural education could be utilized in mathematics classrooms. The history of mathematics could support teaching and learning in various ways. It can make mathematics to be seen more interesting and closer to students' lives rather than a rigid discipline. Besides, it motivates students that mathematics was created to give answer people's everyday needs.

2.2.2. Ways to Use History of Mathematics in Mathematics Education

It is important for teachers and students to know how to make use of the history of mathematics in the teaching and learning of mathematics. There are many ways of integrating the history of mathematics into mathematics lessons. Grugnetti (2000) explained that knowledge is no more a mere collection of facts. Importance should be attached to inherent relativity of knowledge by teachers. But, if history of mathematics is introduced by a teacher or more specifically, if a mathematician is introduced to students by a teacher, then the political, social and economic context in which the mathematician live should be taken into consideration. Otherwise, anachronism may occur. Grugnetti has listed various methods for integrating the history of mathematics into the mathematics lessons as follows:

- By using TVpreious problems, students can compare their strategies with the original ones. In …observing the historical evolution of a concept, pupils will find that mathematics is not fixed and …definite.

- History of the establishment of mathematical skills and concepts; i.e. the evolution of them.
- A historical and epistemological analysis will allow teachers to understand why a certain concept is …difficult for students (p.30).

Furinghetti (2000) recommends a process for using the history of mathematics in teaching of mathematics. This process includes these following steps:

- knowing the sources
- singling out topics suitable for the class
- analyzing the needs of the class
- planning the classroom activities
- carrying out the project
- evaluating the activities (p.57)

According to NCTM (1998), the history of mathematics might not serve its purposes unless there were concrete purposes in presenting it in mathematics classes. Classroom climate, teachers' ingenuity, students' readiness can affect the way to use the history of mathematics. Brief historical anecdotes and class discussions or working on a problem from a great mathematician could be some of these ways also. While learning the history of mathematics, students could see that mathematics is an accumulation of years going on in a certain way for a long time of learning and discovery.

Fried (2007) claimed that curriculum makers can also benefit from insights into the development of ideas. Historical vignettes, teaching modules on historical topics, presentations of mathematical topics according to their historical development, and collections of original texts are some of the ways for introducing the history of mathematics into the instructions.

Although there are attempts for including the history of mathematics in the teaching of mathematics, there are some difficulties in the attempt for combining them. One of such difficulties is that the obligation to teach modern mathematics and modern mathematical techniques through applied sciences pushes the importance of history aside or distorts it even if one wants to use historical topics and the historical approach in teaching mathematics. Fried (2001) suggests two solutions to come over this difficulty. These are "radical separation" and "radical accommodation". He defines radical separation as "putting the history of mathematics on a separate track from the ordinary course of instruction" and radical accommodation as "turning the study of mathematics into the study of mathematical texts".

In another study of Fried (2008), he concerned that what educators have to concern in combining history and mathematics education is how to do it: What examples should one choose for what material? What kind of history of mathematics activities can be incorporated into the ordinary mathematics curriculum? How does one find time for such activities? How does one find a place for this in teacher training? Yet, when one follows these questions to their theoretical end, one begins to see a theoretical problem. He also developed his suggestions and expressed some ways in order to integrate of history to mathematics curriculum. The history of mathematics can be combined to mathematics education with a strategy called the strategy of addition. Historical anecdotes, short biographies, isolated problems are some of the means of this strategy where the history of mathematics is added to the curriculum. Another strategy named as the strategy of accommodation which also tries to give answers to the question of teacher as "Where do I find the time to teach history?" use an historical development in one's explanation of a technique or idea or organize subject matter according to an historical scheme.

Tzanakis (2000) stated that there are different views about the role of the history of mathematics in teaching mathematics. If the views are seen as a continuum, then one side of the continuum is the deductive approach and the other side is the historical approach. In deductive approach, the historical part of the subject is ignored and the results are given importance where the aim is to simply teach the concepts, theorems and proofs. The other side of the continuum is the historical approach. This approach deals with the actual evolution of the concepts, proofs or ideas. It supports the use of original historical books, papers, etc. The historical approach differs from the deductive approach in that the first one does not adopt a simple and apparent method in teaching mathematics, because it tries to pursue the same way as the evolution of a subject did. He recommends both sides of the continuum to be followed. Also, he suggests a stance between the deductive approach and historical approach. Such stance between the two extremes is the genetic approach. He gives a basic, brief outline to follow in the genetic approach:

i. The teacher or author has a basic knowledge of the subject's history.
ii. The crucial steps of the historical development have been thus appreciated.

> iii. Key ideas and problems that stimulated this evaluation are reconstructed in a modern context so that they can become didactically appropriate for the introduction of new concepts, methods and theories. This usually implies that the historical evaluation is not respected in any strict sense.
> iv. Many details of this reconstruction are given as exercises, which, in this way, become essential for a full understanding of the subject (p. 112).

In the article "Integrating the History of Mathematics in Educational Praxis", how to design activities integrating the history of mathematics with educational praxis was explained. There was an example where the topic "moments" was explained by using ideas from the 14th century. In the activity of uniform motions, the graph of velocity vs. time was used. In finding the area of the figure between time axis and the velocity curve, they made use of the Euclidean geometry. Such a simple geometric transformation could lead to equivalent motion problems in the real context (Farmaki *et al.*, 2004). They said that they used the integration of historical data in designing the activities in such a way that history is not visualized as the main element in the classroom. This type of integration is described by Tzanakis and Arcavi (2000) as

> "… a reconstruction in which history enters implicitly; a teaching sequence is suggested in which use may be made of concepts, methods and notations that appeared later than the subject under consideration, keeping always in mind that the overall didactic aim is to understand mathematics in its modern form". (p.210)

According to Tzanakis and Arcavi (2000), possible ways for employing the history of mathematics in the instruction of mathematics are stated as follows:

i. Historical snippets: Mathematical text books which include historical information are in this category. Historical snippets could be in the form of factual data like "photographs, facsimiles of title pages or other pages of books, biographies, attribution of authorship and priorities, anecdotes, dates and chronologies, mechanical instruments, and architectural, artistic, or cultural designs". Other types of snippets contain conceptual issues such as "narrative touch upon motivation, origins and evaluations of an idea, ways of noting and presenting ideas as opposed to modern ones, arguments (errors, alternative conceptions, etc.), problems of historical origin, ancient method of calculation".
ii. Research project based on history texts: At any grade level, student research projects could be applicable and useful. In such projects, the focus can be on "the nature and structure of mathematics as a science with particular regard to

its methods, theories and organization so as to elucidate philosophical issues, historical developments, or the social role of mathematics".

iii. Primary sources: This category includes original sources which could be used in mathematics courses.

iv. Worksheets: They could include historical extracts which can be in the form of historical information to describe the context, discussion of mathematical issues, comparison of the past and present versions of mathematical topics or ancient notations.

v. Historical packages: Collection of materials narrowly focused on a small topic, with strong ties to the curriculum, suitable for two or three class periods, ready for use by teachers in their classrooms.

vi. Taking advantage of errors, alternative conceptions, change of perspective, revision of implicit assumptions, intuitive arguments: Using the history of mathematics into mathematics instruction could be beneficial because it makes possible for us to hold up examples from errors, alternative conceptions, and changes of perspective concerning a subject, paradoxes, controversies and revision of implicit assumptions and notions, and intuitive arguments.

vii. Historical problems: Such problems might be effective for students and teachers. There are different types of historical problems like problems with no solution, famous problems still unsolved, or solved with great difficulty, problems having clever, alternative, or exemplary solutions, problems that motivated and/or anticipated the development of a whole (mathematical) domain, or simply problems presented for recreational purposes.

viii. Mechanical instruments: Using these instruments in the teaching of mathematics is related with two interconnected problems which are socio-cultural development of mathematical awareness, and building up an empirical basis for mathematical proofs.

ix. Experiential mathematical activities: Such activities may come in different forms such as reminding students of the arguments, notations, methods, games and other ways of doing mathematics in the past.

x. Plays: They can be used in the classroom in two ways, namely re-experiencing the life of mathematicians in the past and re-enacting the famous arguments in history.

xi. Films and other visual tools: Movies, posters displaying portraits of mathematicians, time charts with chronological or thematic historical developments are in this category.

xii. Outdoor experiences: Identification of forms and shapes, patterns in nature, in architecture (past and present) and in art.

xiii. The WWW: A resource and as a means of communication in integrating the history of mathematics into the instruction of mathematics.

So, various ways were recommended by several researchers for integrating the history of mathematics into the mathematics instructions for benefiting from the long historical progress and mathematics human mind. In the teaching and learning process, the appropriate methods may be chosen according to the need and context of the topic.

2.3. Studies on the History of Mathematics

Mathematics is one of the ancient fields of human discipline. So, it entails a valuable and rich history to use. With the help of the history of mathematics, students may feel that mathematics is related with the human beings and their needs. They can understand that mathematics is not an isolated discipline which includes a set of meaningless and abstract information. If the history of mathematics is not taught at school, students can perceive mathematics as dead (Heiede, 1996).

In what areas could integrating the history of mathematics into the mathematics classes be effective is an important question for teaching of mathematics. A panel discussion which was about "The Role of the History of Mathematics in Mathematics Education," at the second International Conference on the Teaching of Mathematics (ICTM-2) in 2002 was concerned also with this question. The history of mathematics might be useful in terms of making students have positive attitudes towards mathematics.

Many studies (Awosanya, 2001; Carter, 2006; Goodwin, 2007; İdikut, 2007; Liu, 2003; Marshall, 2000; Philippou and Christou, 1998; Sassano, 1999; Tözlüyurt, 2008) explain the importance of the history of mathematics in mathematics education as it makes mathematics more interesting and meaningful and promote the use of the history of mathematics during mathematics classes. The purpose of a study was to explore the relationship between the knowledge of the history of mathematics of high school teachers and their opinions in mathematics (Goodwin, 2007). The research questions were as: a) What sort of mathematic opinions do high school teachers have?, b) What do high school teachers know about the history of mathematics? and c) What is the relationship between high school teachers' knowledge of the history of mathematics and their opinion in mathematics?

This was a quantitative study where a survey research design was employed. The Likert type "Mathematics Images Survey" and "History of Mathematics Test" were mailed to 900 high school teachers and 193 surveys were received. A significant relationship was found between the knowledge of the history of mathematics of teachers and their opinions in mathematics. Teachers who have high history scores gave more importance to research. They also thought that mathematics is for everyone, ongoing and shows cultural differences. But teachers having low history scores saw mathematics as a disjoint collection of facts, rules and skills. The researcher (Goodwin, 2007) also stated that

> further studies are needed examining the relationship between the students' knowledge of the history of mathematics and their opinion of mathematics (p. 500).

The aim of the study of Marshall (2000) was to indicate that negative attitudes of many high school students towards mathematics could be positively affected by using the history of mathematics in mathematics lessons. 55 mathematical problems were selected from the history of mathematics and they were applied to 10th and 11th grade level mathematics lesson in a high school Algebra class. The research questions were:

> To what degree students' attitudes towards mathematics are changed by systematically bringing the history of mathematics into a secondary school mathematics classroom? b) Which of the attitudes, as defined and measured by Sandman's model (1974), are the most and least affected by the insertion of historically based activities? c) What is the impact on students' attitudes of using activities taken from historical modules as expressed by the students themselves? d) What classroom practices emerge when the history of mathematics becomes a regular part of the discourse in a secondary school mathematics class (p. 50).

Both quantitative as well as qualitative methods data analysis were used in this research. For quantitative data, mathematical content knowledge assessments and Sandman

Mathematics Attitude Inventory were administered. Sandman's open-ended test includes the following questions: a) what is mathematics; b) what does it mean to learn mathematics; c) what is the purpose of studying the history of mathematic. For qualitative data; student's journals, classroom observations, interviews were collected. According to the researcher, the mixed method was preferred for this study because such influential factors as attitudes are difficult to assess. As a result of this, multiple research methods had to be chosen. Below is the model which was developed for the related students attitudes and outcomes (See Figure 2.1). Sandman's Attitude inventory measures six different contracts like: perceptions of mathematics teachers; anxiety towards mathematics; value of mathematics in society; self-concept in mathematics; enjoyment of mathematics and motivation in mathematics.

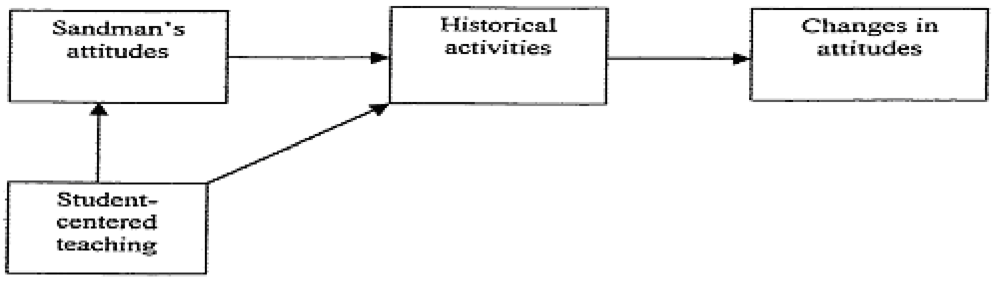


Figure 2.1. Sandman's model for relating students' attitudes and outcomes.

According to Marshall (2000), using the history of mathematics is important in allowing students to see the value that people have attached to mathematics for centuries. It can also make mathematics more enjoyable and pleasurable. The results reveal that there were no statistically significant changes in the attitude scores. Qualitative studies were made with 4 target students. The analysis of qualitative data indicated an increase in their perception of their mathematics teacher, an increase in the enjoyment of mathematics, and a decrease in mathematics anxiety.

The study of Awoyanya (2001) is a mixed method study where both quantitative and qualitative research methods were used. Quasi-experimental method with pretest-posttest control group design was used for quantitative study. The experiment was conducted during Algebra 2 course for 12th grade students. There were two classes in Algebra 2 courses and one of the classes was the experimental group and the other one was the control group. The research hypothesis was that students in the experimental group that use history along with their lessons perform better than students in the control group whose mathematics lessons were devoid of history. In the control group, necessary formulas for concepts related to mathematics or topic of the subject were taught. However, in the experimental group, the historical origin of the concepts and some mathematicians who were pioneers of those concepts were used during the lessons. Florida Comprehensive Assessment Test and an achievement tests were used as pretest and posttest respectively. Qualitative study supported the quantitative study in which follow-up interviews were used to obtain in-depth information about using history in the teaching of mathematics. The results showed that there is a significant difference between the performance of the control group and the experimental group. The average of the scores in the experimental group was higher than the scores in the control group. The results of the qualitative analysis also supported the fact that using history of mathematics in teaching mathematics makes it easy to understand and learn mathematics better.

In the study “Using the history of mathematics for mentoring gifted students: Notes for teachers”, Yevdokimov (2007) presented a teaching-learning model where the history of mathematics was integrated with problem solving activities. Fifteen 11th grade students were selected for the study by their mathematics teachers to take part in the program. The basic criterion in selection was that they were identified as gifted or very good at mathematics. Thus, the methodology consisted of interactions among researcher and teachers, researcher and students. Teachers were interviewed and students were thought episodes. For evaluation, teachers gave feedback on the program. Teachers’ idea proved that working with gifted students would be more promising and easy to pursue, if historical perspective was included in the teaching learning environment.

While studies encourage supporting the mathematics instructions with the history of mathematics, there have not been enough research studies in Turkey on integrating history of mathematics into mathematics lessons. There is a need to conduct some research studies on the effectiveness of the history of mathematics, as a supportive factor as well (İdikut, 2007; Tözluyurt, 2008; Karakuş, 2009). Giving the required importance to the history of mathematics in the teaching of mathematics could add a more dynamic nature to mathematics. What’s more, mathematics history offers an extensive basis about interesting problems. Teachers, who give place to history of mathematics in their lessons, may help their students to see the changing and developing structure of mathematics. Also, to investigate the works of different mathematicians may provide the student to improve several solutions in problem solving.

The aim of the study of İdikut (2007) was to understand the effects of the use of the history of mathematics as a supportive technique in mathematics classes on students' attitudes, mathematics performance and retention levels. The experimental study was a pretest-posttest control group design which was applied to the seventh grade students. There were two groups from two different schools where one group was the control group and the other one was the experimental group. Before the experiment, the attitude scale and a performance test were used as a pretest. Then, teacher guide booklet was followed in the control group, while additional history of mathematics technique was used in the experimental group for four weeks. The two scales were again used in both groups. Three weeks later, the performance tests were used again in order to examine the retention levels of students, t-tests were used in the analysis of the performance test and the attitude scale. Results showed that the history of mathematics supported lessons did not have any effects on students' attitudes and retention levels but the lessons integrated with the history of mathematics were much more effective in terms of success in mathematics.

The research, in which activities chosen from the history of mathematics are used on the subject of "numbers", was made in Turkey by Tözlüyurt (2008) in order to understand the effects of using the history of mathematics in learning and teaching of mathematics. The research question was "What are the perceptions of senior high students regarding the lessons, in which activities chosen from the history of mathematics are used in learning numbers?" 8 students from public high school of foreign languages were selected and interviewed. The aim of this interview was to identify their ideas towards integrating the history of mathematics in mathematics lessons. Phenomenographic method was used in the analysis part. Results showed that students have positive conceptions of integrating the history of mathematics into learning and teaching mathematics during mathematics lessons. Importantly, students explained that although they think mathematics is a difficult subject, during lessons where the history of mathematics was used, they had more fun and found the lessons more pleasurable. By using the history of mathematics they could grasp the complex and difficult parts of mathematics better because of its additional meaning to the mathematics lessons.

Gönülateş (2004) determined the prospective teachers' attitudes toward utilizing the history of mathematics. Their ideas about in what ways they could use it were examined. The study also includes an experimental part where the effect of the change of students' attitudes and views about using the history of mathematics on their future teaching practices was analyzed. This experimental part was implemented in the "Teaching Methods in Mathematics" course of the prospective teachers that contains examples and materials about integrating the history of mathematics into mathematics courses and activities which rise prospective teachers' qualification regarding the implementation the history of mathematics integrated instructions. The design of the study was pre-test post-test quasi experimental design. The study presented qualitative data, as well. "History in Mathematics Teaching Attitude Scale" and "Math History with Teaching Strategies Scale" were used before and during the methods course. Results showed that there was no significant increase in terms of attitudes but the number of strategies for possible uses of the history of mathematics in mathematics lessons altered and went up.

In addition, the aim of the study of Karaduman (2010) was to improve the understanding and retention levels of subjects by utilizing from the history of math. Quantitative research design was implemented in this research. The research was carried out in two groups; experimental-control groups with random assignments of classes to treatment groups. The experimental group students were instructed with a differentiated curriculum by utilizing from the history of mathematics. The control groups were instructed with the traditional curriculum. The sample size of the study was 90 students (45 of experimental group, 45 of control group) from a public primary school. The data for research were collected by Mathematics Achievement Test. Demographic analyses, Chi-Square Test and a Paired-Samples t-test Analysis were used for testing the hypothesis. According to pre-test, post-test results, it was obtained that where differentiated curriculum was used, where the history of mathematics was utilized, math students understand the subject more easily in classroom. So, it was concluded that integrating history and mathematics instruction develops problem-solving skills, lays a foundation for better understanding, helps students make mathematical connections, and highlights the interaction between mathematics and society.

Studies on the history of mathematics showed that the history of mathematics in mathematics lessons could have several effects on attitudes, images, performances, self-confidence etc. generally in a positive way. In Turkey, research studies on this issue are limited. So, more studies are needed for measuring the effectiveness of using the history of mathematics in mathematics instructions.

In addition, mathematics curriculum in Turkey includes some goals about the role of history of mathematics and the effects of students' positive attitudes toward mathematics for increasing the quality of teaching and learning process. One of the aims of the last mathematics curriculum – 2005 – is to make students understand the historical development of mathematics as well as the historical development of human mind. Another goal is to increase students' positive attitudes toward mathematics and help them have self-confidence (MEB, 2009). These new goals in the curriculum affect the content of all mathematics text books in primary and middle schools. 6^{th}, 7^{th} and 8^{th} grade text books have some parts about the history of mathematics in them. However, these parts about the history of mathematics are not integrated with units, they appear like separate parts (see Appendix A).

The literature review showed that studies generally support to utilize from history of mathematics during mathematics instructions in order to increase students' academic performance and positive views about mathematics by offering more opportunities from history to learn mathematical concepts and procedures. Also, current mathematics curriculum emphasized some goals which call for using the history of mathematics during mathematics instructions as well as supporting students to increase their mathematics attitudes. Moreover, research has shown that self-efficacy corralates with mathematics attitudes (Michaelides, 2008). So, by taking into account the need to make more research studies in Turkey about the effects of history of mathematics integrated instructions, this study aims to create a study where the history of mathematics is integrated with related subjects and to observe its possible effects on students.

3. SIGNIFICANCE OF THE STUDY

Mathematics provides a solid basis to many aspects of everyday life and affords a comprehension of the complexities in different situations. Hence, these features make mathematics to be of great importance. International exams like TIMMS, PIRLS or PISA are from the noteworthy projects which obtain comparative data about student performances between countries, so that the countries could make evaluations about their education levels. Results of international exams show that Turkish students' performance in mathematics is far more than many countries (IEA, 2009; OECD, 2004). For example, according to last PISA exam of OECD, Turkish students' performance in mathematics is statistically significantly below the OECD average (OECD, 2009). So, in order to support the teaching and learning process of mathematics, some important steps should be taken. One of these steps may be integrating the history of mathematics into the mathematics courses. Teaching mathematics from a historical perspective will lead to greater understanding, student inspiration, motivation, excitement, varying levels of learning, and appreciation of the subject (Carter, 2006).

In Turkey, utilizing from history of mathematics is supported in general aims of mathematics education and national mathematics curriculum also. One of the aims of the mathematics curriculum refers to utilizing the history of mathematics during mathematics lesson and also middle grade mathematics text books include some parts of history of mathematics. But, as mentioned before, these parts are at the beginning of some units as reading texts or within the units as little notes about history (see Appendix A). The information about the history of mathematics is not connected with the related topic in the books. Although mathematics text books in middle grade level includes disconnected parts about history of mathematics, studies support that history of mathematics could be more useful, if it is integrated into the topics related to it (Awosanya, 2001; Carter, 2006; Goodwin, 2007; İdikut, 2007; Liu, 2003; Marshall, 2000; Sassano, 1999; Tözlüyurt, 2008). By this way, students can feel that the historical part of mathematics is not completely different from what they learned. Also, they could see that mathematics is not separable from life and human beings have been constantly dealing with mathematics throughout the history. Such kind of practices creates a feeling that mathematics can be thought very well with a connection to its origin.

Moreover, studies show that there is a need for making more research on the history of mathematics in order to examine the effect of history of mathematics on both teaching and learning of mathematics in Turkey (İdikut, 2007; Tözluyurt, 2008). As a result, this study examines the effects of a mathematics unit which is integrated with the history of mathematics on students' mathematics self-efficacy and achievement on mathematics. The aim is to show instructions that are integrated with the history of mathematics might be more effective on students' positive self-efficacy and achievement.

As a treatment topic of the study, "The volumes of the pyramid, cone and sphere" topic was selected from 8^{th} grade mathematics topics to be integrated with the relevant information on the history of mathematics. This topic takes part in the 5^{th} unit "Measurement in Geometric Shapes and Perspective" in mathematics curriculum. A topic from geometry was selected for this study because students face many geometric shapes, figures or objects in their daily lives. They take advantage of geometry to explore the space, to maintain their occupations or to solve basic problems in everyday life like painting, drawing, wallboard, modeling (Turgut and Yılmaz, 2007). Thus, as a requirement of its nature, geometry is one of the ancient topics of mathematics. It has very old roots, even older than the invention of scripture. It emerged from practical reasons like marking the borders or proportions and taxes (Bunt *et al.*, 1988; Tez, 2008). Studies on geometry show that geometry is very significant for the human life and people are used to deal with it for ages. So, mentioning the old historical roots of geometry related to the mathematics instructions in the lessons may help students perform better and understand the source of what they learn, so that they may increase their positive feelings toward mathematics. More specifically, the treatment topic is finding the volume of pyramids, cone and sphere has also ancient roots. These concepts have been worked on since before Chris (Bunt *et al*, 1988). So, showing that people have been trying to find solutions to the problems about these concepts for thousands of years may attract students' attention and increase their motivation.

Thus, this study will be carried out to develop an instructional design to integrate history of mathematics with mathematics instructions, and might be used as a guideline for further studies. The study also conducted to examine how students' mathematics self-efficacy and achievement will be affected from the instruction which exemplifies the integration of the history of mathematics with the selected unit.

4. STATEMENT OF THE PROBLEM

The purpose of this study is to investigate the effectiveness of the instruction integrated with history of mathematics on students' self-efficacy towards mathematics as well as mathematics achievement levels. Also students' views about instruction integrated with history of mathematics will be included. Volumes of pyramid, cone and sphere topics were selected from eight grade mathematics curriculum in order to conduct the study.

4.1. Research Questions & Hypothesis

This study questions the difference on students' mathematics achievement and mathematics self-efficacy levels after being treated with two different types of instructions in a selected topic. More specifically, the research questions and hypothesis of the study are:

i. Is there any significant difference in the achievement levels of 8^{th} grade students after they receive different instructions (regular instruction or instruction integrated with history of mathematics) on volume of pyramid, cone and sphere topics?

- 8^{th} grade students who received instruction integrated with history of mathematics will have significantly higher scores on post measure (*TVpost*) in comparison to those who received regular instruction on volume of pyramid, cone and sphere topics.

ii. Is there any significant difference in the self-efficacy levels towards mathematics of 8^{th} grade students after they receive different instructions (regular instruction or instruction integrated with history of mathematics) on volume of pyramid, cone and sphere topics?

- 8^{th} grade students who receive instruction integrated with history of mathematics will receive significantly higher scores in posttest of *Mathematics Self-efficacy Scale* in comparison to those who received regular instruction on volume of pyramid, cone and sphere topics.

iii. What are the views of 8^{th} grade students who received instruction integrated with history of mathematics after the treatment?

4.2. Variables and Operational Definitions of Variables

This study purposes to investigate the effects of different types of instructions (instruction integrated with history of mathematics and regular instruction) on students' mathematics achievement and mathematics self-efficacy levels. Therefore, the dependent variables of the study are *students' mathematics achievement levels* and *mathematics self-efficacy*. The independent variable of the study is the type of instruction for eight graders on volume of pyramid, cone and sphere topics; namely *regular instruction* and *instruction integrated with history of mathematics.*

4.2.1. Dependent Variables

i. Mathematics achievement levels
ii. Students' self-efficacy toward mathematics
iii. Students' views on history of mathematics integrated instructions

Mathematics Achievement Levels of students were measured by achievement tests in two steps:

- *Test-Volume (TV)* was used as pretest as well as the posttest. It aims to assess the required prerequisite knowledge of students for the treatment topic "volumes of pyramids, cone and sphere" and also to check the achievement levels of students in treatment topics if students know the related concepts or not beforehand (see Appendix B). In posttest, it aims to assess the achievement levels of students in volume of pyramid; cone and sphere topics (see Appendix C).

Students' *self-efficacy toward Mathematics* as variable refers to the definition of Bandura (1994);

> people's beliefs about their capabilities to produce designated levels of performance that exercise influence over events that affect their lives" (p. 71).

Self-efficacy was assessed by an instrument called;

- *Mathematics Self-efficacy Scale* was used with a pretest-posttest design for checking a change in the self-efficacy of students towards mathematics. The instrument was developed by Umay (2001) by three dimensions which are respectively "self-perception", "awareness from their behaviors in mathematics subjects" and "converting mathematics to life skills" (see Appendix D).

Students' views on history of mathematics integrated instructions were measured by two instruments:

- *Evaluation Instrument* also includes some open ended questions named as *TVpre-Part1* for obtaining students' evaluations about history of mathematics integrated lessons (see Appendix C)

- An *Interview Instrument* was developed by the researcher in order to clarify the ideas of students about history of mathematics integrated instructions so as to assess their attitudes qualitatively (see Appendix E).

4.2.2. Independent Variables

Type of Instruction for 8^{th} grade students on volume of pyramid, cone and sphere topics is the independent variable of the study. Regular instruction and instruction integrated with history of mathematics are two types of instruction. Both of them were developed according to the objectives of the 8^{th} grade mathematics curriculum, as clarified in the Teacher Guide Book of Ministry of Education for grade 8 and Unit 5 "Measurement in Geometric Objects and Perspective" (Aygün *et al.*, 2009). The objectives for selected topics "volumes of pyramid, volume of cone and volume of sphere" are stated in Appendix F. More details about the instructions will be given in "Design and Procedure" part.

Regular instruction included similar activities and procedure as indicated in Teacher Guide Book for 8th grade volume of pyramid; cone and sphere topics (see Appendix G).

Instruction integrated history of mathematics was designed according to the same Teachers Guide Book through integrating the basic knowledge about the history of mathematics and geometry related with the selected topics. The main points while integrating history to mathematics instruction were: i) what kind of necessitates encourage people to develop geometry and volume concept in the history or ii) who were the first scientists who developed the concepts and formulas associated with the topics (see Appendix H). *Instruction integrated with history of mathematics* was designed according to the definition of Tzanakis and Arcavi (2000) about integration of historical data in designing activities, which is *"a reconstruction in which history enters implicitly, a teaching sequence is suggested in which use may be made of concepts, methods and notations that appeared later than the subject under consideration, keeping always in mind that the overall didactic aim is to understand mathematics in its modern form."* (p.210).

Both of the instructions included similar sequences of introduction, activity and problem parts during lessons as well as similar context of activities. Also, PowerPoint presentation was used in both types of instruction. The main difference between the instruction integrated with history of mathematics and the regular instruction is that the introduction part of the topics, the directions of warm-up activities and the forms of problems were supported by explanations about associated history of mathematics or the presentations of the related famous mathematicians. On the other hand, in control groups, these introduction, activities or problem parts do not include any historical perspective. The other difference is the devoted time to treatment topics. It lasted 8 hours for the control groups while 9 hours for the experimental groups, which means that one more lesson hour was dedicated to the experimental groups for integrating the history of mathematics parts.

5. METHODOLOGY

5.1. Sample

The study was conducted in two public schools (Fatih Sultan Mehmet Primary School and Akşemseddin Primary School) which are located in Istanbul Başakşehir region. All eight grade students (N=553) from these schools were considered as the target population and determined by convenient sampling for practical reasons. The researcher took permission from Ministry of National Education in order to carry out the study in these schools (see Appendix I). In School 1, there were six eight grade classes (n=253) and in School 2 there were ten eight grade classes totally (n=300). Two classes from each school were attained to treatment groups randomly, one as control group and one as experimental group. As a result; totally four classes, two experimental and two control groups, served as the sample of the study. Control classes received the regular instruction and experimental classes treated with the instruction integrated with history of mathematics. In total, 144 students were participated in the treatment from both of the schools. But, because some did not participate some of the tests and they were excluded from the sample of the study. As a result of this, the sample of the study composed of 131 students.

5.2 Design

As it was mentioned before, the purpose of this study is to develop an instruction integrated with history of mathematics and then explore the effects of the treatment on students' mathematics self-efficacy and achievement levels.

In choosing the schools convenient sampling was used so design of the study is quasi experimental (Gay *et al*., 2006). Thus, totally four classes from two state supported schools were assigned as treatment groups. The researcher determined the experimental and control groups by random selection in each school. So, the design is nonequivalent control group design because it involves random assignment of intact groups to treatments (Gay *et al.*, 2006). In each school, one group was the control group and received *regular instruction*; the other group called the experimental group and *instruction integrated with history of mathematics* was given them.

Before implementing the treatments, *Test-Volume- Pre (TVpre)* was administered in all control and experimental groups as a pre test. This instrument had three parts. First part *(TVpre - Part1)* included an open-ended question which asks students whether they learn about history of mathematics in their previous lessons and if they remember anything about it. This question was asked for obtaining data concerning students whether they have any background knowledge about history of mathematics or not. Questions in the second part of the instrument *(TVpre - Part2)* were designed in order to examine students' knowledge level connected to the prerequisites of the treatment topics - volume of pyramids, cone and sphere -. Finally, the last part of the instrument *(TVpre - Part3)* contained questions to check if students have any background information about the treatment topics. In addition, *Mathematics Self-Efficacy Scale* was administered to all intact groups as a pre-test in order to measure subjects' self-efficacy towards mathematics.

After applying the pretests (*TVpre* and *Mathematics Self-Efficacy Scale*), control groups received the regular instruction, that is the instruction which is stated in the Teacher Guide book and experimental groups received the instruction aimed to supplement the exiting curriculum with history of mathematics in volume of pyramid, cone and sphere topics. Following the treatment, *Mathematics Self-Efficacy Scale* was administered again as the post-test to the treatment groups for clarifying if there were any positive change took place in students' self-efficacies towards mathematics. What's more, *Test-Volume- Post (TVpost)* was applied as a post-test after the treatment. In fact, there were two parts in *TVpost*. The first part (*TVpost - Part1*) was applied only to experimental group students. This part included several open ended questions which are composed for obtaining experimental group students' evaluations about history of mathematics integrated lessons by personal declarations after the treatment. The second part (*TVpost - Part2*) was applied to both control and experimental group students for measuring students' mathematics achievement level in relation to selected subjects; volume of pyramids, cone and sphere.

After the pre-tests, treatments and post-tests, a semi structured interview was conducted to six students from each experimental class to collect qualitative data to flourish the quantitative data. The interview was conducted with experimental group students about their ideas on mathematics history integrated instructions with an aim of triangulation of data obtained from other instruments and getting more in-depth answers from students.

Table 5.1 summarizes the design of the study:

Table 5.1. Design of the study.

PRE-MEASUREMENT	TREATMENT	POST-MEASUREMENT
• Mathematics Self-Efficacy Scale	• Control group: regular instruction for subjects "volume of pyramid, cone and sphere"	• Mathematics Self-Efficacy Scale
• Test- Volume- Pre (TVpre) Scale	• Experimental group: instruction integrated with history of mathematics for subjects "volume of pyramid, cone and sphere"	• Test- Volume- Post (TVpost) Scale • Interviews

5.3. Instruments

The instruments used in this study are developed in order to assess students' mathematics achievement levels and self-efficacy towards mathematics dealing with the topic of volume of pyramid, cone and sphere.

The instruments used for assessment of the variables are as follows:

i. Achievement Tests
   - *TVpre*

- *TVpost*

ii. Mathematics Self-efficacy Scale

iii. Interview Instrument

5.3.1. Achievement Tests

Both achievement tests were developed by the researcher to measure students' mathematics achievement before and after the treatment in selected topic. *TVpre* was conducted before the treatments and *TVpost* was applied after the treatments, namely regular instruction and instruction integrated with history of mathematics. Both instruments were formed of questions with diverse item types such as true-false, short answer, checkbox, filling the tables, drawing shapes, matching, filling the blanks, short explanation. The instruments were implemented to the sample lasting in 40 minutes.

5.3.1.1. *TVpre* was composed of three parts, as *TVpre-Part1*, *TVpre-Part2* and *TVpre-Part3*. All control and experimental group students were administered the same test before the treatment. *TVpre-Part1* includes an open-ended question which asks students if they have learned history of mathematics in their previous lessons and if they remember anything about history of mathematics. The questions were asked for obtaining data about students if they have any background knowledge on history of mathematics. They are as follows:

- *Do you learn any information about the history of the topics you encounter during your mathematics lessons? If so, how?*
- *Could you give two examples of the topics about history of mathematics you remember?*

In order to measure students' knowledge on the prerequisite topics for the volume of pyramid, cone and sphere, questions in *TVpre-Part2* were asked to the students. The prerequisite knowledge includes general characteristics of prisms and cylinder, the volume of prisms and cylinder, the area formulas of basic shapes like circle, square, and triangle. *TVpre-Part2* covers questions from 2 to 7 in *TVpre* (see Appendix B). Some of these prerequisite questions were taken directly and the rest of them were modified from Student Course Book for Grade 6 and Grade 7 prepared by the Ministry of National Education. Furthermore, *TVpre-Part3* contains questions about the selected treatment topic to check if students know the treatment topic beforehand. Questions from 7 to 16 involved in *TVpre-Part3* were about the volume of pyramids, cones and spheres and relationship among their volumes with the volumes of prisms and cylinders. The questions were developed according to the objectives selected from the "volume of pyramid, cone and sphere" topic in "Measurement in Geometric Shapes and Perspective" unit in the 8th grade mathematics curriculum by taken directly or modified from Student Course Book for 8th graders.

For analysing data gathered using this instrument, the researcher developed a rubric and four judges, two graduate students, one mathematics teacher and one academician, evaluated the rubric. With the feedback and contributions of judges, the rubric acquired its last form and afterwards, the data obtained from *TVpre* were analyzed according to this final version of the rubric by the researcher (see Appendix J). The rubric only includes *TVpre-Part2* and *TVpre-Part3* parts. *TVpre-Part1 (evaluation instrument)* evaluated in analysis of open-ended questions and interview questions part separately (see section 7.2).

Validity and Reliability Analysis of the Instrument: The validity analysis of the instrument was made qualitatively. One experienced mathematics teacher and one mathematics education academician examined the test for the content validity.

Reliability is related to the consistence of scoring of a test. If there was no consistency among the scores, then the scores obtained from one administration of a test would be completely different from the scores when this test would be retried. So, to ascertain the consistency precisely in scoring the items, inter-rater reliability analysis was conducted. To determine inter-rater reliability, a mathematics teacher scored 35 randomly selected answer sheets. She scored the items according to the original rubric which had developed by the researcher. Then, Pearson-r correlation coefficient was determined between the two rater's (researcher and a teacher) scoring. The Pearson-r Correlation Coefficient was calculated as r= 0.99 with p= .00 in terms of two raters' scores for the whole scale, which means that there is an agreement among two raters.

5.3.1.2. *TVpost* was applied to control groups and experimental groups in two different forms namely Form A and Form B as posttest. The instrument in Form A is composed of two parts, as *TVpost-Part1* and *TVpost-Part2* where the experimental group students from the two of the schools were administered (see Appendix C). The instrument in Form B is comprised of only *TVpost-Part 2* which the control group students from both schools were answered (see Appendix C).

TVpost-Part1 was given to experimental group students to answer three open-ended questions for obtaining students' evaluations about history of mathematics integrated lessons by personal declarations after the treatment. The experimental group students were asked to write down their likes and dislikes about the history of mathematics integrated instructions, how were the effects of such instructions on their learning and also should the history of mathematics be integrated to their next mathematics instructions.

Apart from *TVpost-Part1, TVpost-Part 2* contains questions about the treatment topics which are the volume of pyramids, cones and spheres and the relation of their volumes along with the volumes of prisms and cylinders. The questions were prepared according to the objectives selected from the "Volume of pyramid, cone and sphere" topic in "Measurement in Geometric Shapes and Perspective" unit in the 8^{th} grade mathematics curriculum by taken or modified from Student Course Book for 8^{th} graders and modified. The questions in *TVpost-Part2* in posttest are developed as parallel questions of *TVpre-Part3* in pretest in order to check if there is an increase in students' achievement levels in selected treatment topics.

For analyzing data gathered from the sample using this instrument, the researcher developed a rubric by taken the feedback and evaluation of four judgments of experts consisting of two graduate students, one mathematics teacher and one academician. With the contributions of judges, the rubric took its last form and the data obtained from *TVpost* were analyzed according to this final version of the rubric by the researcher (see Appendix K). The rubric only includes *TVpost-Part2*. *TVpost-Part1* will be evaluated in analysis of open-ended questions and interview questions part separately (see section 7.2).

Validity and Reliability Analysis of the Instrument: One experienced mathematics teacher and one mathematics education academician examined the test for the content validity.

In order to determine the consistency in scoring the items, inter-rater reliability analysis was conducted. For finding out inter-rater reliability a mathematics teacher scored 35 randomly selected answer sheets. She scored the items according to the original rubric which had developed by the researcher. Then, Pearson-r correlation coefficient was determined between two rater's scoring. The Pearson-r Correlation Coefficient was calculated as r= 0.99 with p= .00 in terms of two raters' scores for the whole scale which means that there is an agreement among two raters.

5.3.2. Mathematics Self-efficacy Scale

The attitudes of students towards mathematics were assessed by *Mathematics Self-Efficacy Scale* which was developed by Umay (2001). The instrument was conducted to all the control and experimental groups as pretest at the beginning of the study and as posttest at the end of the study after the treatments. The test contains 14 items with 5-Likert type ranging as never, rarely, sometimes, usually, and always (see Appendix D). The highest point which could be taken from the instrument is 90 and the lowest point is 14. The highest point taken from the instrument shows that students' self-efficacy toward mathematics is high, so their self confidence for mathematics achievement is high as well. The instrument includes eight positive (1,2,4,5,8,9,13,14) and six negative (3, 6, 7, 10, 11, 12) items.

The scale contained items such as;

- I think mathematical in planning my day/ time.
- I can solve every kind of mathematics problem if I struggle enough.
- I believe that it is impossible for me to master mathematics as my around.
- I realize that my self-confidence decreases while studying mathematics.

It has three dimensions which are "self-perception", "awareness from their behaviors in mathematics subjects" and "converting mathematics to life skills" (Umay, 2001). The items 3, 10, 11, 12 and 13 are for the first domain; the items 4, 5, 6, 7, 8, and 9 are for the second domain and the items 1, 2 and 14 are for the third domain.

Validity and Reliability Analysis of the Instrument: While the reliability of the instrument was determined with the Cronbach Alpha Coefficient which was found as .88 for the sample of 127 undergraduate students, the median of validity factor of scale items were found as .64 for investigating the validity of the scale and this value was accepted as valid by Umay (2001).

5.3.3. Interview Instrument

An interview instrument was prepared by the researcher in order to obtain more in-depth information on students' ideas on history of mathematics integrated instructions. After the treatment, a semi structured interview was conducted with 12 experimental group students from two schools. The interviews lasted around five minutes for each student.

For interviews students were chosen based on the results of *Mathematics Self-efficacy Scale* and the results of *TVpre-Part1* which probes students if they learn history of mathematics in their previous lesson and remember anything about mathematics history. Students were selected in the following way only from experimental classes of both of schools:

- Students who have top two and bottom two scores from Mathematics Self-Efficacy Scale.
- One student from both experimental classes who claim that they learn history of mathematics in their previous lessons and remember the most.
- One student from both experimental classes who claim that they do not learn history of mathematics in their previous lessons and not remember anything.

5.4. Procedure / Treatments and Instructional Materials

This part involves a description of the two types of treatments, namely regular instruction and instruction integrated with mathematics history, in selected topic which takes part in "Measurement in Geometric Shapes and Perspective" chapter of the 8th grade mathematics curriculum. The instructions were given by the researcher in both control and the experimental groups in the two schools. The instructions endured for eight hours in the control groups as it was determined in the mathematics curriculum and nine hours in the experimental groups - one more hour was necessary for including history of mathematics indeed - . Table 5.2 shows the time schedule of the treatments.

Furthermore, the volumes of pyramid, cone and sphere topics were selected to design instructions for both types of treatments. The volume subject was included in all grades of the middle school. Students were acquainted with the volume of prisms and cube in the sixth grade. The seventh grade curriculum involved the volume of cylinder. In the eighth grade level, students required associating what they learned in the previous grades about the volume concept and concluded the volume of pyramid, cone and sphere by using this previous knowledge; that is to say; the volume of prisms and cylinder (see Appendix L). Sources of mathematics history also prove that the volume of pyramids, cone and sphere were emerged from utilizing the volume of prisms and cylinder in the prehistoric times. Thus, the 8th grade curriculum was more proper to integrate the topic about volume concept with related history of mathematics, so that the similarity between the process of emergence of concepts and the methods of teaching these volume concepts in today's education system could be shown.

Table 5.2. Time schedule.

(1 hour means 1 lesson hour which corresponds to 40 minutes)

Date	Fatih Sultan İlköğretim Okulu 8D: Control Group 8E: Treatment Group	Akşemseddin İlköğretim Okulu 8H: Control Group 8A: Treatment Group
	1st week	
April 27, 2010		8A- 2 hours: 1 hour: pretest; 1 hour: volume of pyramid
April 28, 2010		8H- 2 hours: 1 hour: Pretest; 1 hour: volume of pyramid
April 29, 2010		
April 30, 2010		8A-2 hours: volume of pyramid
	2nd week	
May 10, 2010		8H- 2 hours: volume of pyramid; volume of cone
May 11, 2010		8A-2 hours: volume of cone
May 12, 2010		8H- 2 hours: volume of cone
May 13, 2010		
May 14, 2010		8A-2 hours: volume of cone; volume of sphere
	3rd week	

Table 5.2. Time schedule (continued).

May 17, 2010	8E- 2 hours: 1hour: Pretest; 2 hours: volume of pyramid 8D- 2 hours: 1 hour: Pretest; 2 hours: volume of pyramid	8H- 2 hours: volume of sphere 8H- posttest 8A– 2 hours: volume of sphere
May 18, 2010	8D- 2 hours: volume of pyramid; volume of cone	8A- posttest 8A- interview
May 19, 2010	HOLIDAY	
May 20, 2010		
May 21, 2010	8E- 2 hours: volume of pyramid	
4th week		
May 24, 2010	8E- 2 hours: volume of cone 8D- 2 hours: volume of cone	
May 25, 2010	8D- 2 hours: volume of sphere	
May 26, 2010	8E- 2 hours: volume of cone; volume of sphere	
May 27, 2010	8D- posttest	
May 28, 2010	8E- 1 hour: volume of sphere 8E- Posttest	
5th week		
May 31, 2010	8E- Interview	

Although the treatment topics were volume of pyramid, cone and sphere both for control and experimental groups, these topics were integrated with related history of mathematics knowledge in treatments of experimental groups.

The instructions integrated with mathematics history were prepared by utilizing the following subjects from the history of mathematics:

i. Emergence of geometry in Egypt
ii. Works of Euclid about volume of pyramid and cones
iii. Works of Archimedes about the volume of spheres

The rest of this part includes some brief review about the related subjects mentioned above in which the treatment topic based upon:

i. Emergence of geometry in Egypt: In Prehistoric times, nearly 97 per cent of the land of Egypt was not appropriate for agriculture. Only 3 per cent of the land around the Nile could be used as lifeblood. It was analyzed that spring flooding of the Nile destroyed the fields, so the Egyptians should mark the borders of their fields after the spring flooding as they paid taxes proportional to the size of their fields. As a result of this, they needed basic knowledge about arithmetic and geometry. A typical characteristic of the Early Egyptians was their lack of knowledge about general rules and procedures. They gave the computations but did not specify any generalizations or procedures as to how they established their methods. Their main concern was to obtain practical results (Bunt *et al.*, 1988; Tez, 2008). One of the most noteworthy accomplishments of Egyptians was the invention of the measurement of volumes. In this study, data from history of mathematics literature were used as an introduction part in treatments of experimental groups.

Most of the mathematical data of the Egyptians appear on two sources because the others disappeared throughout the history. These sources were the Rhind papyrus and the Moscow papyrus (Struik, 2002). One of the problems of the Moscow papyrus is enquired the calculation of the volume of a truncated pyramid which directly deals with the treatment topic and was conducted as an activity in the experimental classes in this study.

ii. Works of Euclid about volume of pyramid and cones: Euclid, who was a famous Greek mathematician, wrote the “Elements” which consists of 13 books. He collected many old texts and compiled the past works and his own works in the book called “Elements”. It was the first important treatise on this subject. He used the deductive method in a systematic and logical way. Still today, the geometry of Euclid’s books is taught in high schools. This work of Euclid was the second popular book - the first was Bible- which was printed, translated and studied mostly. The book was written with a pure and precise logic and language in about 300 BC (Bunt *et al.*, 1988; Cooke, 1997; Dönmez, 1986; Struik, 2002; Tez, 2008).

The “Elements” covers the following on the pyramids and cones (Friberg, 2007; p.189):

> “Every triangular prism can be cut (by two planes through four of the six vertices) into three triangular pyramids (not similar to each other). The three sub-pyramids have, two by two, equal heights, and bases of equal areas. Therefore, the volume of each one of them is one third of the volume of the triangular prism.” In Elements XII.7
> “Any (circular) cone is a third part of the (circular) cylinder which shares the same base and the equal height with it”. In Elements XII.10

These theorems were straightly parallel with the volume formula of the pyramids and cones from treatment topics. In today’s eight grade national mathematics curriculum, students are expected to realize that pyramids are one third of the prisms and so, their volumes are one third of the volume of the prism. Moreover, the volume formula of cones also equals to one third of the cylinders, based on the similar logic as the “Elements” of Euclid.

iii. Works of Archimedes about the volume of spheres: Archimedes, a multifaceted scientist, wrote a book as “On the Sphere and Cylinder” in which he explained the volume of sphere (Sertöz, 1994). He found out that the volume of a sphere is four times the volume of a cone with a base that has the same size as the biggest circle in the sphere and with a height that is the same as the radius of the sphere. He also noticed that the volume of the cylinder is 3/2 times bigger than that of the sphere circumscribed by that cylinder, which has the base same as the biggest circle in the sphere and has the same height as the diameter of the sphere (Cooke, 1997; Sertöz, 1994).

Also, in the eighth grade mathematics course books, it is clearly mentioned that the volume of the sphere is 2/3 of the cylinder that is circumscribed by the sphere in which cylinder has same height as the diameter of the sphere and same base as the biggest circle in the sphere. Using history of mathematics in teaching these formulas creates a light on how these concepts originate as well as renders the concepts more manmade. By benefiting from mathematics history in mathematics instructions, students can see the human effect in history and the evolutions and sensible way to grow concepts. So, the treatment for this study grounded on the deductions obtained from this part will be explained in subsequent part which is instruction integrated with history of mathematics.

Bearing them in mind, by giving instruction integrated with history of mathematics for volume of pyramids, cone and sphere topics considered in this study, it is obvious that treatment topics in 8^{th} grade level intended to reinforce the existing curriculum with historical data about mathematics and the concept of volume. Instruction integrated history of mathematics covered: i) what kind of things were needed to foster people to develop geometry and volume concept in the history or ii) which scientists first developed the concepts and formulas related with the topics. Mathematics history related with treatment topics were utilized by integrating it with the instruction stated in Teacher Guide Book.

Instructions integrated with history of mathematics were designed according to the definition of Tzanakis and Arcavi (2000) about integration of historical data in designing activities, which is "*a reconstruction in which history enters implicitly, a teaching sequence is suggested in which use may be made of concepts, methods and notations that appeared later than the subject under consideration, keeping always in mind that the overall didactic aim is to understand mathematics in its modern form.*" (p.210).

What's more, since the instruction integrated with history of mathematics highlighted the contributions of human beings and their demands to the evolution and development of mathematics, it was based on the definition of Man-Keung (2000) where mathematics was defined as

> a human endeavor which has spanned over four thousand years; it is a part of our cultural heritage; it is a very useful, beautiful and prosperous subject. (p.3)

Considering them, knowledge and some anecdotes about the evolution and development of geometry and volume concepts were given to students in this study. Moreover, the famous mathematicians related with the topic were mentioned. Some original historical problems as well as some problems formed in historical aspects were also presented to experimental group students to solve. So; some of the possible ways like historical snippets, worksheets and historical problems which were stated by Tzanakis and Arcavi (2000) were implemented in the history of mathematics integrated instructions. Some of the activities and examples were applied as it is appeared in the 8^{th} grade Teacher Guide Book for "Measurement in Geometric Shapes and Perspective" chapter while some of the activities and examples were adapted and prepared by the researcher for integrating history of mathematics to mathematics instructions (see Appendix H). The instructions were given by researcher to all the control and experimental groups in both schools. The treatment continued eight hours for control groups while nine hours for experimental groups; one more hour for integration of history of mathematics parts.

In the first three lessons, the subject was volume of pyramid. The instruction began with a review of prerequisite knowledge for learning the volume of pyramid. Students were expected to solve the related questions from Test-Volume- Pre (*TVpre*) about the volume of prism and teacher made a summary about the required prior knowledge for the related topic. After the review, students were asked a question for making predictions about the volume of an Egypt pyramid with given dimensions. With a short PowerPoint presentation, students were explained the famous pyramids were in Egypt, distinctive information was clarified to students about the Egypt pyramids and so that they could be encouraged to start a new topic. This introduction with mathematics history part continued approximately fifteen minutes. At the end, students were asked why Egyptians could be pioneer in primitive geometry hundreds of years ago or what kind of needs induce them to develop geometry in history. Students discussed the reason of need for emerging and improving geometry and specifically volume concept in history. Then, students were shown a presentation where they learn basic knowledge about the history of geometry and the volume concept. These parts were about the integration of history with the topic.

After a brief summary on the history of treatment topic was given, students were mentioned concerning Euclid was the first scientist who proposed the volume of pyramid and cone in the history in his book named “Elements”. Then students were shown a short presentation about the life and works of Euclid. In the presentation, there was a revelation for Euclid’s find which is the volume of pyramid by using the volume of prisms; and also the volume of cone by using the volume of cylinder. In the end, students were motivated to discover the volume of pyramid in the “Sand Pyramid” activity via using their knowledge about the volume of prism.

After being motivated, students discussed and compared their results and ideas. Following that, the teacher explained the exact result of Euclid about the volume of pyramid, concluded with the formula and finally she applied the formula in an example question. After learning the formula, students were also given an original problem from an historical document which is from Moscow Papyrus. They were told that Egyptians tried to solve the same problem before Christ. Later, students were given several key words to assist them to create and solve a problem about the volume of pyramid by using those key words.

The next point is about the subject of fourth, fifth, and sixth lessons. The subject was about volume of cone. Students solved the prerequisite questions from *TVpre* about the subject and the teacher made a summary on the required prerequisite knowledge for the related topic. After the review, students were expected to guess the volume of an ice cream cone with given sizes. Then, they were expected to make the “Load and Unload” activity where they were asked to find the volume of cone by using the volume of cylinder. Their attentions were attracted by explaining that the great discovery of famous mathematician Euclid. That is; the volume of cone which is discovered by using the volume of cylinder in prehistoric times with similar reasoning. For the next move, students shared and discussed their results with their classmates. Then, the teacher explained the result of Euclid about the volume of cone and justified the formula concluding by application of the formula in an example. After that, students solved a problem about the volume of cone which was modified so as to include an historical aspect. Afterward, they were given some key words and expected to create a problem by using these words and then solve that problem. At the end, students solved the practice problems from their text books about the volume of cone.

The last two lessons were on the volume of sphere. After a short review of teacher about the prerequisite knowledge for the volume of sphere, a presentation telling the life and works of Archimedes were shown to the students. In the presentation, it was mentioned that Archimedes created the volume formula of sphere in history. After the presentation, students were encouraged to discover the volume of sphere in the "Ping Pong Ball and Box" activity by applying their knowledge about the volume of cylinder. Following the students comparing their results and ideas, the teacher gave the result of Archimedes about the volume of sphere and concluded by the formula. After that, teacher applied the formula in an example. A problem like a short historical story was given to students to solve. Then, they were expected to form a problem by using the given key words and solve it. Finally, they solved exercise problems from their text book about the subject.

Regular instruction on 8^{th} grade volume of pyramids, cone and sphere topic was designed according to text book and teacher's guide book of Ministry of Education (Aygün *et al.*, 2009). Students followed the activities about volumes and solved problems in exercise parts of their mathematics text books; found the relationship between the volumes of pyramid, cone and sphere with prism and cylinder. They developed the volume formula of pyramid, cone and sphere by using the formulas of prisms and cylinder. Then they did the exercises in their books. The activities and problems in the mathematics text book did not include any historical aspect in teaching the subjects about volumes. Details can be seen in Appendix G.

Two types of instruction were different in terms of devoted time to the treatment topic. It lasted 8 lesson hours for the control groups while 9 hours for the experimental groups. One more lesson hour was dedicated to the experimental groups for integrating history of mathematics parts. Moreover, the introduction parts of the topics in instruction integrated with history of mathematics were supported by short explanation about associated history of mathematics and the presentation of the famous mathematicians related with topics while introduction parts in regular instructions did not include any historical aspects. The activities in which students develop the volume formulas for pyramids, cones and spheres were the same in both types of instruction as stated in the teacher's guide book, but the directions in the warm-up activities in instructions integrated with history of mathematics may increase the interest of students and evoke the human facet of mathematics because famous mathematicians found the related formula in history were stated or the emergence of the related concepts were explained. On the other hand, same activities were done by control group students without mentioning them about the mathematician and history of the emergence of the related volume formula. The problems in different types of instruction aimed at assessing the same knowledge and progress of students but with different forms. Problems in instruction integrated with the history of mathematics included original historical problems or problems with historical anecdotes. In parts where students were expected to form and solve problems by themselves related with the topics, they were given some hint words to use. In instruction integrated with history of mathematics, some hint words about history were given to students in addition to other hint words. So, the basic difference between instruction integrated with history of mathematics and regular instruction was integrating the history of mathematics into introduction, activities and problem parts of the topics and preparing them in historical perspective in the former.

The similarities between two types of instruction were seen in the context of the activities where students created the formulas for pyramids, cones and spheres. A PowerPoint presentation was used in the introduction part in both types of treatments. The sequences of introduction, activities or problems were parallel in instruction integrated with history of mathematics and regular instruction. The practice part at the end of each topic was similar for the two types of instruction.

6. DATA ANALYSIS

In order to answer the research questions, both quantitative and qualitative data were used. While quantitative data were obtained from *TVpre-Part2*, *TVpre-Part3* and *TVpost-Part2*, qualitative data were obtained as a result of administering *TVpre-Part1, TVpost-Part1* and *Interview Instrument*. Scores obtained from *TVpre-Part1*, *TVpre-Part2*, *TVpost-Part2* and *Mathematics Self-efficacy Scale* was in interval level. Mathematics Self-efficacy Scale was administered to both of the groups as pretest and posttest. TVpre (Test-Volume-Pre) was administered at the beginning of the study and TVpost (Test-Volume-Post) was administered at the end of the study to all groups.

As it was stated before, the study was conducted in the two public schools. In each school, one class was randomly assigned as control group and one class was assigned as experimental group. So, there were two experimental groups and two control groups totally. The way of analyzing data and results for each hypothesis and research questions will be given separately for both schools because schools were not selected randomly and students from the two schools were not matched with each other.

Control and experimental groups were determined from pre-existed group; so there may be initial differences between these groups. So, in order to test if the groups were different or not from each other in terms of their prerequisites in mathematics achievement or mathematics self-efficacy, independent sample t-tests were conducted separately. Details for both schools will be given in “Results” part.

In School 1, the number of the subjects in experimental group was 33 and control group 30. In School 2, experimental group consisted of 35 students and control group consisted of 33 students. So, in all groups the number of the subjects was above 30. Normality test was conducted to pretest and posttest scores of students in control and experimental groups to check if the variable measured is normally distributed for the sample. The distribution of *Mathematics Self-efficacy Scale* as pretest and posttest, *TVpre-Part2*, *TVpre-Part3*, *TVpost-Part2* and *TVpre*, *TVpost* scores of students in each group were tested by normality tests of Kalmogorov- Smirnov and Shapiro – Wilk. The results of these tests show that these scores are not significantly different from the scores which have normal distribution out of three measurements (See Appendix M).

In *results* part, mean and standard deviations of the groups were given as descriptive statistics. T-test was carried out as inferential statistics in order to get information whether instruction integrated with history of mathematics have an effect on 8^{th} grade students' mathematics achievement and self-efficacy towards mathematics. Specifically, in order to examine whether there is any statistically significant effect of different types of instructions (instruction integrated with history of mathematics and regular instruction) on 8^{th} grade students' mathematics achievement and mathematics self-efficacy, independent sample t-tests were used between the posttest scores of the experimental and control group students. So, independent sample t-test was carried out in order to test whether there is any significant difference between posttest scores of the control and the experimental groups.

In addition to testing the hypothesis, analysis of open-ended questions and interview questions was also conducted. As it was stated before, *TVpre-Part1* aims to obtain data about students' background on history of mathematics and in *TVpost-Part1* experimental group students' views on history of mathematics integrated instructions were asked. Descriptive statistics of data gathered from these parts were analyzed and the frequency distribution of the control and the experimental groups' answers were calculated. Also, subjects' responses to the interview instrument were obtained to provide more in-depth data about history of mathematics integrated instructions. The descriptive statistics and frequency distributions will be given in the "Results" part.

7. RESULTS

Quantitative analysis which was done for testing the hypothesis of the first and second research questions will be given for *TVpre-Part2*, *TVpre-Part3*, TVpost-Part2 and *Mathematics Self-efficacy Scale* in the first part of this section. Then in the second part, analysis of open ended questions and interview questions based on the descriptive statistics will be given for *TVpre-Part1*, *TVpost-Part1* and *Interview Instrument*.

7.1. Statistical Analysis for Testing Hypothesis

Research question 1: Is there any significant difference in the achievement levels of 8^{th} grade students after they receive different instructions (regular instruction or instruction integrated with history of mathematics) on volume of pyramid, cone and sphere topics?

Hypothesis 1 8^{th} grade students who received instruction integrated with history of mathematics will have significantly higher scores on post measure (*Test-Volume-Post*) in comparison to those who received regular instruction on volume of pyramid, cone and sphere topics.

As it was mentioned before, because convenient sample selection technique was used, generalization of the results is not possible, so each hypothesis of the related research question will be tested individually for each school.

For School-1, the means and standard deviations of students' scores in experimental and control groups assessed by *TVpre-Part3* and *TVpost-Part2* are shown in Table 7.1. *TVpre-Part3* contains questions about the selected treatment topic to check if students know the treatment topic beforehand and was applied as pretest. *TVpost-Part2* includes parallel questions with *TVpre-Part3* about the treatment topic and was conducted as posttest. The mean of the scores in both *TVpre-Part3* (pretest) and *TVpost-Part2* (posttest) were calculated and it is found to be M= 17,48 in pretest; M= 47,27 in posttest for experimental group and M= 17,43 in pretest; M= 44,90 in posttest for control groups. The mean values show that the experimental group students' achievement level is higher than the control group students in posttest measurement. There is an increase in post scores of both experimental and control group students comparing with their pretest scores.

Table 7.1. Descriptive statistics of TVpre-Part3 and TVpost-Part2 scores- School 1.

		Mean	Std. Deviation	N
TVpre-Part3	Experimental Group	17,48	7,47	33
	Control Group	17,43	8,97	30
	Total	17,46	8,15	63
TVpost-Part2	Experimental Group	47,27	10,43	33
	Control Group	44,90	10,03	30
	Total	46,14	10,23	63

Before testing the hypothesis, primarily it should be determined whether the prerequisite test (*TVpre-Part2*) scores of students who were treated with both regular instruction and instruction integrated with history of mathematics is significantly different or not. Independent sample t-test was used between the prerequisite test scores of the two groups (see Table 7.2). Results show that there is not any statistically significant difference between prerequisite test scores of these two groups.

Table 7.2. Independent samples t-test results between prerequisite test scores of students in experimental and control groups - School 1.

	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
TVpre-Part2	1,04	,31	,56	61	,57	1,03	1,82

As mentioned above, results based on prerequisite test (*TVpre-Part2*) indicate that there is not any statistically significant difference between prerequisite test scores of control and experimental groups in School-1. In order to test the *hypothesis 1,* independent sample t-test was carried out between the *TVpost-Part2* (contains questions about the treatment topic) scores of the participants in the experimental and control groups in order to determine whether there is a significant difference between the posttest scores of two groups (see Table 7.3). As it is seen in Table 7.1., although mean scores of experimental group was higher than the control group, results display that there is not any significant difference on posttest scores of experimental and control group students; which indicate that different types of treatments do not have any effect on achievement levels of students; t= ,91; p= ,36 for School 1. So this result does not support the research hypothesis (1) or fail to reject null hypothesis.

Table 7.3. Independent samples t-test results between the posttest scores of students from experimental and control groups - School 1.

	F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
TVpost- Part2	,01	,92	,91	61	,36	2,37	2,58

For School-2, the mean and standard deviation of students' scores in both experimental and control groups assessed by *TVpre-Part3* (contains questions about the treatment topic in pretest) and *TVpost-Part2* (contains questions about the treatment topic in posttest) are shown in Table 7.4. The mean of the scores in both *TVpre-Part3* (pretest) and *TVpost-Part2* (posttest) were calculated and it is found to be M= 19,42 in pretest, M= 52,74 in posttest for experimental group; and M=21,03 in pretest, M=48,78 in posttest for control groups. The mean values show that the control group students' achievement level is higher than the experimental group students' in pretest but in posttest measurement, experimental group students have higher achievement level than the control group students. It is obvious that there is an increase in post scores of both experimental and control group students when it is compared with their pretest scores.

Table 7.4. Descriptive statistics of TVpre-Part3 and TVpost-Part2 scores - School 2.

		Mean	Std. Deviation	N
TVpre-Part3	Experimental Group	19,42	4,26	35
	Control Group	21,03	4,14	33
	Total	20,20	4,25	68
TVpost-Part2	Experimental Group	52,74	6,05	35
	Control Group	48,78	6,57	33
	Total	50,82	6,57	68

In order to test the hypothesis, it should be determined whether the prerequisite test (*TVpre-Part2*) scores of students who were treated with regular instruction and instruction integrated with history of mathematics is significantly different or not. For determining this, independent sample t-test was used between the prerequisite test (*TVpre-Part2*) scores of the two groups (See Table 7.5). Results show that there is not any statistical significant difference between prerequisite test scores of these two groups.

Table 7.5. Independent samples t-test results between prerequisite test scores of students in experimental and control groups - School 2.

	F	Sig.	t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
TVpre-Part2	,37	,54	1,35	66	,17	1,30	,95

Results based on prerequisite test (*TVpre-Part2*) for School-2 indicate that there is not any statistically significant difference between prerequisite test scores of the control and experimental groups. So, in order test the *hypothesis 1,* independent sample t-test was followed through between the *TVpost-Part2* (contains questions about the treatment topic) scores of the participants in experimental and control group in order to understand whether there is a statistically significant difference between the posttest scores of two groups (see Table 7.6). Results show that there is a significant difference between posttest scores of the experimental and control group students; which point out that different types of treatments have different effects on mathematics achievement levels of students; t= 2,58; p= ,01 for School 2 by a moderate effect size of .6 (df:66, Cohen's d = .6). According to the result, research hypothesis (1) is supported.

Table 7.6. Independent samples t-test results between the posttest scores of students from experimental and control groups - School 2.

		F	Sig.	t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
TVpost-Part2	Equal variances assumed	,73	,39	2,58	66	,01	3,95	1,53

Hypothesis 1 of the first research question tested if 8th grade students who received instruction integrated with history of mathematics will have significantly higher scores on post measure (*TVpost-Part2*) in comparison to those who received regular instruction on volume of pyramid, cone and sphere topics. Results indicated that although the mean scores of experimental group students is higher than the control group students in School 1, there is not any significant difference between the posttest scores of two groups, so this result does not support the hypothesis. On the other hand, in School 2, results showed that there is a significant difference between posttest scores of the experimental and control group students; which indicated that instructions integrated with history of mathematics are more effective on mathematics achievement levels of students. Hence the hypothesis was supported.

Research question 2: Is there any significant difference in the self-efficacy levels towards mathematics of 8th grade students after they receive different instructions (regular instruction or instruction integrated with history of mathematics) on volume of pyramid, cone and sphere topics?

Hypothesis 2. 8th grade students who received instruction integrated with history of mathematics will receive significantly higher scores in posttest of *Mathematics Self-*

efficacy Scale in comparison to those who received regular instruction on volume of pyramid, cone and sphere topics.

As it was stated before, hypotheses of the research questions were tested as individually for each school due to the sampling technique used.

Table 7.7 shows the means and standard deviations of the scores of students in both experimental and control groups in pretest and posttest for *Mathematics Self-efficacy Scale* for School-1. The means of the scores in both pretest and posttest were calculated and it is found to be M= 49,33 in pretest; M= 50,51 in posttest for the experimental group and M=50,06 in pretest; M=51,30 in posttest for the control group. The mean values show that the control group students' mathematics self-efficacy level is higher than the experimental group students' in pretest and posttest measurement. But, there is an increase in post scores of both experimental and control group students when it is compared with their pretest scores.

Table 7.7. Descriptive statistics of pretest and posttest scores of *Mathematics Self-efficacy Scale* - School 1.

		Mean	Std. Deviation	n
Mathematics Self-efficacy Scale-1	Experimental Group	49,33	8,02	33
	Control Group	50,06	5,75	30
	Total	49,68	6,99	63
Mathematics Self-efficacy Scale-2	Experimental Group	50,51	4,89	33
	Control Group	51,30	5,71	30
	Total	50,88	5,27	63

Before testing the hypothesis, it should be determined whether the pretest scores of students in *Mathematics Self-efficacy Scale* who were treated with regular instruction and instruction integrated with history of mathematics is significantly different or not. For determining this, independent sample t-test was used between the pretest scores of the two groups (see Table 7.8). Results show that there is not any significant difference between pretest scores of these two groups.

Table 7.8. Independent samples t-test results between pretest scores in *Mathematics Self-efficacy Scale* of students in experimental and control groups - School 1.

	F	Sig.	t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Pretest (Mathematics Self-efficacy Scale)	2,87	,09	-,41	61	,68	-,73	1,77

For testing the hypothesis, independent sample t-test was carried out between the posttest scores in *Mathematics Self-efficacy Scale* of the participants in the experimental and control group in order to determine whether there is a significance difference between the posttest scores of these two groups (see Table 7.9). Results show that there is not any significant difference on posttest scores of the experimental and control group students; which indicate that different types of treatments do not have any effect on mathematics self-efficacy of students; t= -,58; p= ,55 for School 1. So, this result does not support the research hypothesis (2) or failed to reject null hypothesis.

Table 7.9. Independent samples t-test results between the posttest scores in *Mathematics Self-efficacy Scale* of students from experimental and control groups - School 1.

		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Mathematics Self-efficacy Scale- 2	Equal variances assumed	1,70	,19	-,58	61	,55	-,78	1,33

Table 7.10 shows the mean and standard deviation of the scores of students in both experimental and control groups in pretest and posttest for *Mathematics Self-efficacy Scale* for School- 2. The mean of the scores in both pretest and posttest were calculated and it is found to be M= 52,31 in pretest; M= 52,80 in posttest for the experimental group and M=51,90 in pretest; M=50,90 in posttest for the control group. The mean values display

that the experimental group students' mathematics self-efficacy level is higher than the control group students in pretest and posttest measurement. There is an increase in post scores of experimental group students when compared with their pretest scores; whereas in the control group students there is a decline in post test scores.

Table 7.10. Descriptive statistics of pretest and posttest scores of *Mathematics Self-efficacy Scale* - School 2.

		Mean	Std. Deviation	N
Mathematics Self-efficacy Scale-1	Experimental Group	52,31	4,44	35
	Control Group	51,90	6,85	33
	Total	52,11	5,70	68
Mathematics Self-efficacy Scale-2	Experimental Group	52,80	4,47	35
	Control Group	50,90	4,50	33
	Total	51,88	4,55	68

In order to test hypothesis, it should be determined whether the pretest scores of students in *Mathematics Self-efficacy Scale* who were treated with regular instruction and instruction integrated with history of mathematics is significantly different or not. To understand this, independent sample t-test was used between the pretest scores of the two groups (see Table 7.11). Results show that there is not any statistically significant difference between pretest scores of these two groups.

Table 7.11. Independent samples t-test results between pretest scores in *Mathematics Self-efficacy Scale* of students in experimental and control groups - School 2.

		F	Sig.	t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Pretest (Mathematics Self-efficacy Scale)	Equal variances assumed	5,26	,02	,29	66	,77	,40	1,39

For *hypothesis 2*, as it was mentioned before, results based on pretest (*Mathematics Self-efficacy Scale*) for School-2 indicate that there is not any statistically significant difference between prerequisite test scores of control and experimental groups in School-2. Therefore, independent sample t-test was carried out between the posttest scores in *Mathematics Self-efficacy Scale* of the participants in the experimental and control group in order to determine if there is a significance difference between the posttest scores of these two groups (see Table 7.12). As it was seen in Table 7.10, although mean scores of experimental group students were higher than then scores of control group students, the results show that there is not any statistically significant difference on posttest scores of experimental and control groups; which indicate that different types of treatments do not have any effects on mathematics self-efficacy of students; t= 1,73; p=,08 for School 2. According to this result, the hypothesis (2) is not supported.

Table 7.12. Independent samples t-test results between the posttest scores of students from experimental and control groups - School 2.

		F	Sig.	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Mathematics Self-efficacy Scale- 2	Equal variances assumed	,00	,97	1,73	66	,08	1,89	1,08

So, research *hypothesis 2* of the research question 2 tested if 8th grade students who received instruction integrated with history of mathematics will have significantly higher scores on post measure in *Mathematics Self-efficacy Scale* in comparison to those who received regular instruction on volume of pyramid, cone and sphere topics. In School 1, results showed that posttest scores of experimental group students were lower than the mean scores of control group students in post measure; which indicated that instructions integrated with history of mathematics were not more effective on mathematics self-efficacy levels of students. On the other hand, results indicated that although the mean scores of experimental group students is higher than the control group students in post measure in School 2, there is not any significant difference between the posttest scores of two groups. Hence, the *hypothesis 2.i.* was also not supported for both schools.

7.2. Analysis of Open-ended Questions & Interview Instrument

As it was clarified in the previous sections, there were some open-ended questions in *Test-Volume-Pre and Test-Volume-Post* which were identified as *TVpre-Part1* and *TVpost-Part-1*. *TVpre-Part1* aims to clarify the general picture about students' background on history of mathematics. On the other hand, *TVpost-Part1* includes questions which probe the ideas of the experimental group students on history of mathematics integrated instructions. In addition to open-ended questions in *TVpre* and *TVpost*, there was an *Interview Instrument* which consists of questions about the use of history of mathematics in mathematics instructions and participants' views about such types of instruction. This instrument was used to obtain more detailed information in comparison to the paper pencil instrument results. While *TVpre* instrument was administered at the beginning of the instruction, *TVpost* and *Interview Instrument* were conducted at the end of the treatments. All these qualitative data collection strategies were used to acquire in-depth information.

Descriptive statistics will be given related to qualitative data collected from *TVpre-Part1*, *TVpost-Part1* and *Interview Instrument*. Frequency distribution of the answer categories were analyzed and compared with each other depended on the descriptive statistics. Some of the categories will be exemplified by selected student responses. *TVpre-Part1* was applied to both control and experimental groups while *TVpost-Part1* was conducted only for the experimental group students in both schools. At the end of the treatment, twelve students were interviewed. The way of analyzing data and results for each question will be given separately for each school - School 1 and School 2 - respectively. Triangulation was used to give more detailed picture of the situation, to check the data from multiple sources and gain broader perspectives as a result of using different methods.

The data gathered from *TVpre-Part1*, *TVpost-Part1* and *Interview Instrument* were transcribed and read cautiously for three times. While reading, answers were searched for similar items which were formed as groups according to related categories and patterns. At the end, the categories were shaped by giving them as abbreviation to the entities of data. The qualitative data were also analyzed by a different scorer who is a graduate student in mathematics education, and as a result of comparisons the coding categories of all data were modified and took the last form with agreed abbreviations.

The frequency distribution of data obtained from *TVpre-Part1*, *TVpost-Part1* and *Interview Instrument* were calculated in analysis of each category. In School-1, 33 respondents from the experimental class, and 30 respondents from the control class gave responses to the *TVpre-Part1*. In School-2, 35 respondents from the experimental class, and 33 respondents from the control class gave responses to the *TVpre-Part1*. On the other hand, *TVpost-Part1* was administered only to the experimental group classes in School 1 and School 2, to 33 respondents and 35 respondents respectively. *Interview Instrument* was conducted to twelve students, six students from each experimental class of two schools. The percentages of categories were calculated and evaluated separately for School 1 and School 2.

In *TVpre-Part 1*, students were asked the question *"Do you learn any information about history of the topics you encounter during your mathematics lessons? If so, how? (by teacher, course book, etc.) (Matematik dersleriniz sırasında işlediğiniz konunun tarihi ile ilgili bilgiler öğreniyor musunuz? Öğreniyorsanız nasıl?)"*. Students' answers were transcribed in four categories which are "teacher explains", "from course book", "from Internet" and "no answer". The frequency percentages of categories that students gave to the questions are shown in Table 7.13.

In School-1, most of the experimental group students and the control group students answered the first question as "yes"; 93.3 per cent, 86.6 per cent respectively. The most frequent answer to the question that is regarding how students learn history of mathematics in their lessons was "teacher explains"; 19 students (57.5 per cent) in the experimental group and 21 students (70 per cent) of the control group gave similar answer. The second most frequent response for both experimental and control group was "from course book"; 48.4 per cent in the experimental group and 63.3 per cent in the control group. However, category of "from Internet" took place only in the experimental group with 12.1 per cent. Interestingly, four students from both classes gave answer "yes" to the first question but they didn't respond how they learned it. The percentage of students stated the answer "no" to the first questions was 6.06 per cent in the experimental group, whereas and 13.3 per cent in the control group.

In School-2, the frequency distribution of categories was similar to the School-1. Most of the experimental group students and the control group students gave answer to the first question as "yes"; 86.5 per cent, 67.5 per cent respectively. The most frequent answer to the question about how students learn history of mathematics in their lessons was "teacher explains"; 24 students (86.5 per cent) in the experimental group and 19 students (57.5 per cent) of the control group gave this answer. The second most frequent answer for both experimental and control group was "from course book"; 40 per cent in the experimental group and 51.5 per cent in the control group. Only one student from both experimental and control groups responded to the category "from Internet". Six students from the experimental class and three students from the control class answered "yes" to the first question but they didn't respond how they learned it. The percentage of students stated the answer "no" to the first question was 14.2 per cent in experimental group and 9.09 per cent in control group.

As a result, it means that very high percent of the students - more than 85 per cent of all treatment classes from both schools - claimed that they learned history of mathematics during their lessons. The highest information tool for learning history of the topics during mathematics lessons were indicated as "teacher" by all groups again. Then, the category "from course book" was declared with high percentages in the second order. Very few students gave answer "Internet" to this question. There were students who answered the question as "yes" without giving any response to how they learned.

Table 7.13. Frequency table for the first question of *TVpre-Part1*.

		Experimental group					Control group					
		Number of student	Frequency(%)	Answer to 1a) How do you learn?	Number of student	Frequency (%)		Number of student	Frequency (%)	Answer to 1a) How do you learn?	Number of student	Frequency (%)
SCHOOL-1	Yes	31	93.9	Teacher explains	19	57.5	Yes	26	86.6	Teacher explains	21	70
				From course book	16	48.4				From course book	19	63.3
				From Internet	2	6.06				From Internet	0	0
				No answer	4	12.1				No answer	4	13.3
	No	2	6.06				No	4	13.3			
SCHOOL-2	Yes	30	85.7	Teacher explains	24	86.5	Yes	30	90.9	Teacher explains	19	67.5
				From course book	14	40				From course book	17	51.5
				From Internet	1	2.8				From Internet	1	3.03
				No answer	6	17.1				No answer	3	9.09
	No	5	14.2				No	3	9.09			

Second question of *TVpre-Part 1* is *"Could you give two examples of the topics about history of mathematics you remember? (Hatırladığınız matematik tarihi ile ilgili konulara iki örnek verir misiniz?)"*. Frequency distribution of students' answer categories is shown in Table 7.14 for both schools.

Two basic answer categories came into prominence in all treatment groups which were "geometry works of Atatürk" and "Pythagoras". Atatürk is a familiar name for students and his geometry works were included in the mathematics course books, so high percentage of the answer category "geometry works of Atatürk" was obtained. The other category which remembered mostly is "Pythagoras". "Pythagoras correlation" was the name of a topic in 8^{th} grade mathematics curriculum (Aygün *et al.*, 2009, p. 80). High percentage of this answer category is again as supposedly because students had an opportunity to repeat the name of Pythagoras during that topic and also this study was carried out in 8th grade so that the probability to remember what they learned could be higher.

The third most frequent category was that "Fibonacci" again for both schools. Other categories were represented only by one student from some of the classes. Thus, although most of the students said "yes" to the first question about if they learn history of mathematics related with their mathematics topics during their lessons, they remember just few topics. This result may be because of shortage of integration of mathematics history parts to related topics in mathematics books. Parts about mathematics history appear like separate episodes in books only to read. They are not incorporated to mathematics topics. So it is clear that, students could remember that they learn some information about history of topics during mathematics lessons but they could not even recall many of the names of history of mathematics parts.

Table 7.14. Frequency table for the second question of *TVpre-Part1*.

	SCHOOL 1		SCHOOL 2	
	Frequency (n=33)	Frequency (n=30)	Frequency (n=35)	Frequency (n=33)
Geometry works of Ataturk	36.36	43.33	42.85	33.33
Pythagoras	51.51	26.66	31.42	30.30
Thales	3.03	0	0	0
Fibonacci	15.15	6.66	8.5	9.09
Farabi	0	0	0	3.03
Harezm	0	0	2.85	0
Omar Khayyam	0	0	2.85	0
Archimedes	0	0	2.85	0
Pascal	3.03	3.33	2.85	3.03
Heron	3.03	3.33	0	0
Cahit Arf	0	0	2.85	3.03
No answer	30.30	36.66	42.85	36.36

The first question of *TVpost-Part1* is *"What are your thoughts about history of mathematics integrated lessons on volume of pyramid, cone and sphere topics? What are favorable aspects of you? Why? What are not favorable aspects of you? Why? (Piramitlerin, koninin ve kürenin hacmi ile ilgili matematik tarihiyle desteklenmiş dersler hakkındaki düşünceleriniz nelerdir? Hoşunuza giden yönler nelerdir? Nedenleri? Hoşunuza gitmeyen yönler nelerdir? Nedenleri?)"*. In Table 7.15, the categories for the first question are seen. This part was answered only by the experimental group students of both schools. 69 per cent of the experimental group of first school and 64 per cent of the experimental group of the second school thought that the lessons were enjoyable. Similarly, 41 per cent of the first group and 45 per cent of the second group found the lessons interesting. Categories about understanding and learning had also high probabilities. The percentage of students who stated the category "better understanding" was about 53 per cent in School 2 and 37 per cent in School 1. In a way this result supports the quantitative analysis of the data. Students with large majority have positive views on history of mathematics integrated instructions.

Furthermore, the categories for negative answers were formed as "long questions", "too many formulas", "boring", "no, I don't like", and "difficulties in construction problems" in Table 7.23. 21 per cent of the first group and 14 per cent of the second group only stated the answer "no" without giving any explanation about its reason which means that although they gave answer "no" to this question they were not stated anything about treatments they don't like. The highest frequency about the explanations why they don't like history of mathematics integrated lessons was the category "long questions". The percentage of the experimental group students of School 1 who states that they have difficulties in constructing problems were higher than the experimental group of School 2, again consistent with quantitative analyze of data because students in School 2 had higher achievement on posttest about treatment topic.

Table 7.15. Frequency table for the first question of *TVpost-Part1*.

Positive	SCHOOL-1	SCHOOL-2
	Frequency (%) (n=33)	Frequency (%) (n=35)
Interesting	41.21	45.7
Enjoyable	69.3	64.2
Learned history of related topic while learning the subject	33.33	34.2
Like the examples about history of mathematics	6.06	11.4
Better understanding	37.2	52.8
Negative		
Long questions	18.18	14.2
Too many formulas	9.09	8.5
Boring	9.09	11.4
No, I don't like	21.21	14.2
Difficulties in constructing problems	12.12	5.7

Second question enquired students *"How did mentioning about history of mathematics of related topic during instruction affect your learning? (Ders sırasında ilgili konunun matematik tarihinden bahsedilmesi öğrenmeni nasıl etkiledi?)"*. The most frequent answer category seen for both experimental classes from two schools was "understanding better". As it is seen from frequency percentages; the percentage of experimental class of School 2 is higher than the experimental class of School 1 – 49 per cent and 40 per cent respectively - (see Table 7.16). In the second most frequent category, students gave the answer that they found the lessons interesting – 37 per cent and 39 per cent respectively-. The answer "I learned the subject matter and its history together during mathematics lessons" is represented in the category of "learning history of mathematics and mathematics subject together" This category was stated as the third most frequent category in both experimental classes. "I learned the subject and history of what we learned better" is an example sentence that students stated in answering this question and transcribed as category "learning more on mathematics subject". Other columns are about the effect of such instructions on usage of mathematics on daily life and the permanency of the knowledge they learned in such lessons. No one said that his/her learning was negatively affected during the treatments. Also, ten per cent of the first experimental group and six per cent of the second experimental group did not answer this question. So, this shows that experimental group students in both school claimed that the history of mathematics integrated lessons had positive effects on their learning.

Table 7.16. Frequency table for the second question of *TVpost-Part1*.

	SCHOOL-1	SCHOOL-2
	Frequency (%) (n=33)	Frequency (%) (n=35)
Learning history of mathematics and mathematics subject together	24.24	20
Interesting	37.2	39.4
Better understanding	39.3	48.8
Learning more on mathematics subject	9.09	14.2
Effect on daily life	9.09	8.5
Permanent knowledge	6.06	8.5
No answer	9.09	5.7

Last question of *TVpost-Part1* was *"Should related history of mathematics parts of subjects be integrated to your next mathematics lessons also? Why? (Konuların ilgili matematik tarihi kısımları bundan sonraki matematik derslerine de dahil edilmeli mi? Neden?)"*. 12 per cent of the first experimental group and 14 per cent of the second experimental group stated "yes" without giving any explanation about the reason. Other students who claimed that history of mathematics should be included in mathematics instructions gave reasons like "enjoyable", "better understanding", "learning the origin and history of the topics" and "permanent knowledge". Again, most frequent answer was "better understanding" with 41 per cent and 48 per cent for two experimental class respectively. In the second most frequent category students stated that the lessons were enjoyable for them. On the other hand, about six per cent of first experimental group and five per cent of other experimental group expressed this last question as "no, the mathematics lessons shouldn't be integrated with history of mathematics' without giving any reason to their judgments. Also, the ones who stated that mathematics lessons should not be incorporated with history of mathematics gave reason as "boring" with about three per cent of experimental group in School-1 and six per cent of experimental group of School-2 (see Table 7.17). So, very high percentage of experimental group students leaned toward integration of history of mathematics to related topics.

Table 7.17. Frequency table for the last question of *TVpost-Part1*.

	SCHOOL-1	SCHOOL-2
	Frequency (%) (n=33)	Frequency (%) (n=35)
Yes	12.12	14.2
Enjoyable	33.3	42.8
Better understanding	41.21	48.5
Learning the origin and history of the topics	24.24	25.7
Permanent knowledge	6.06	14.2
No	6.06	5.7
Boring	3.03	5.7

After the treatments, a semi structured *Interview Instrument* about students' views on history of mathematics integrated instructions was implemented to 12 students from experimental groups of School 1 and School 2 regarding to the predetermined criteria mentioned in the instrument part (see section 5.3.3., p. 42.). The first question of this instrument was *"What are the differences of the lessons we have processed together from your lessons so far? (Birlikte işlediğimiz derslerin şimdiye kadarki matematik derslerinden farkları nelerdir?)"*. The most frequent answer was "learning the history of subjects" (see Table 7.18). Also, the categories like "making activities", "visual lessons", and "enjoyable lessons" have been declared with high percentages in both classes. Moreover, there were a few students who stated that the treatment lessons provided them permanent knowledge and cultural background. They claimed positive ideas of them about the treatment lessons.

Table 7.18. Frequency table for the first question of *Interview Instrument*.

	SCHOOL-1	SCHOOL-2
	Frequency (%) (n=6)	Frequency (%) (n=6)
Making activities	50.0	66.6
More understandable	16.6	33.3
Learning the history of subjects	83.3	76.6
Enjoyable	66.6	50.0
Visual	66.6	50.0
Permanent knowledge	0	16.6
Cultural background	16.6	0
Teacher effect	33.3	30.3

In the second question, students were answered the question *"What do you remember from history of mathematics parts of subjects you learned during lessons? Explain by giving two examples. (Derste işlenen konunun matematik tarihi ile ilgili olan kısımlarından neler hatırlıyorsunuz? İki örnek vererek açıklayınız)"*. The frequency distribution of categories indicates that the answers on "Euclid-pyramids", "Archimedes-example question", "Archimedes-volume of sphere" and "Egypt pyramids" had the highest percentages (see Table 7.19). Also, other topics about history of mathematics like "Archimedes - lifting force of water", "Moscow papyrus" and "Hourglass" which were mentioned during treatments were recalled by some students with similar percentages also.

Table 7.19. Frequency table for the second question of the *Interview Instrument*.

	SCHOOL-1	SCHOOL-2
	Frequency (%)	Frequency (%)
Euclid-pyramids	66.6	33.3
Archimedes-example question	50.0	66.6
Archimedes-volume of sphere	66.6	83.3
Archimedes- lifting force of water	16.6	16.6
Egypt pyramids	50.0	66.6
Moscow papyrus	33.3	16.6
Hourglass	16.6	16.6

In the third question of the *Interview Instrument*, students were asked to state the question *"Which parts mostly attracted your attention during history of mathematics integrated instructions? (Matematik tarihi dahil edilerek işlenen derslerde en çok ilginizi çeken kısımlar hangileriydi?)"*. All of the answers being given by students were about the history of mathematics parts during the instructions (see Table 7.20). The frequency of the answer "Improvements in mathematics during history within limited facilities" was the highest in both of the groups. The second most frequent answer which attracted students' attention during treatments was "Egypt pyramids" with 50 per cent in the first experimental group and 33.3 per cent in the second group. Furthermore, "Archimedes-example question", "Story-like questions" and "Moscow papyrus" were categories given by students with similar percentages.

Table 7.20. Frequency table for the third question of the *Interview Instrument*.

	SCHOOL-1	SCHOOL-2
	Frequency (%) (n=6)	Frequency (%) (n=6)
Archimedes-example question	16.6	33.3
Egypt pyramids	50.0	33.3
Improvements in mathematics during history within limited facilities	50.0	83.3
Story-like questions	16.6	33.3
Moscow papyrus	16.6	33.3

Last question was "How was the effect of such instruction on your mathematics learning and ideas about mathematics? (Bu tür bir dersin, matematik öğrenmeniz ve matematik hakkındaki düşünceleriniz üzerinde nasıl bir etkisi oldu?)". 50 per cent of the experimental group of School 1 and 83.3 per cent of the experimental group of School 2 stated that such lessons were enjoyable and this category was the highest in both groups. The second most frequent answer was on "better understanding". Permanent knowledge of what they learned during lessons was also frequently answered by students. Only 16.6 from both groups indicated that such lessons were "difficult and boring" (see Table 7.21). So, generally they profited from treatment lessons in terms of learning and ideas about mathematics.

Table 7.21. Frequency table for the last question of the *Interview Instrument*.

	SCHOOL-1	SCHOOL-2
	Frequency (%) (n=6)	Frequency (%) (n=6)
Permanent knowledge	50.0	33.3
Enjoyable	50.0	83.3
Better understanding	50.0	50.0
Difficult and boring	16.6	16.6

So, in order to check data from several sources and obtain broader perspectives about the effects of history of mathematics integrated instructions and students' views on such instructions, instruments which includes open-ended questions (*TVpre-Part1* and *TVpost-Part1*) and *Interview Instrument* were also conducted to sample students. *TVpre-Part1* aimed to clarify if students have learned history of mathematics in their previous lessons and if so, what they remember about history of mathematics. The results of *TVpre-Part1* showed that although most of the students in experimental and control groups in both schools stated that they learned history of mathematics in their previous lessons, students remember just few topics which are Atatürk's geometry work and Pythgoras correlation. *TVpost-Part1* which was only implemented to experimental groups of two schools includes questions about obtaining students' ideas on history of mathematics integrated instructions by personal declaration after the treatment. Analysis of answer categories indicated that students generally have favorable declerations on history of mathematics integrated instructions. According to the answers from the three questions of *TVpost-Part1*, students declared with high percentages that such lessons were more enjoyable, increase their understanding and they learned better about the subject as well as the related history of the topic. They also supported the integration of history of mathematics to their future mathematics lessons. After the treatments, *Interview Instrument* was conducted to totally 12 students from both experimental classes of two schools which questioned students' views on history of mathematics integrated instructions. They stated with high percentages that they learned the history of the subject and remembered many examples from the history of mathematics parts of subjects they learned during lessons. They also declared that such lessons were enjoyable, they learned better and they believe that their knowledge was more permanent by this way. Hence, students generally claimed positive ideas about the treatment sessions.

8. DISCUSSION AND CONCLUSION

This study was designed for the purpose to find out the effectiveness of instruction integrated with history of mathematics via practicing the instruction in an experimental design. The lesson plans integrated with history of mathematics about the volume of pyramid, cone and sphere topics were developed after cautious considerations of the evaluation and progress of related mathematics concepts throughout the history under the content of national mathematics curriculum. Also, during preparation of the instructions, examples about the role of history in mathematics education referred in the literature were also examined. So, eight grade students who received instruction integrated with history of mathematics and regular instruction were examined in terms of the effects of different type of instructions on their mathematics achievement levels and self-efficacy toward mathematics. The study offers quantitative and qualitative data collected from 131 eight grade students from two different public primary schools in İstanbul. This section discusses the assertions drawn from the findings of the study in relation to the results with interpretations having regard to the literature, discussing the limitations of the study and offering recommendations for further studies about history of mathematics integrated lessons.

The research method was quasi-experimental design which was implemented in two different schools. In both schools, one class was attained as experimental group and one class as control group. Since schools were selected by convenient sampling, the results could not be generalized, therefore each hypothesis were checked separately for each school. At the beginning of the study, *TVpre* and *Mathematics Self-efficacy Scale* were implemented as pretest. After the treatments were carried out, *TVpost* and *Mathematics Self-efficacy Scale* were applied as posttest. At the end of the treatment, interviews were conducted with 12 selected students.

TVpre has three parts, namely *TVpre-Part1, TVpre-Part2* and *TVpre-Part3. TVpre-Part1* questioned if students have learned history of mathematics in their previous lessons and if they remember anything about history of mathematics. *TVpre-Part2* measured students' knowledge on the prerequisite topics for the volume of pyramid, cone and sphere, and *TVpre-Part3* contains questions about the selected treatment topic to check if students know the treatment topic beforehand. The data obtained from *TVpre-Part1* were examined qualitatively in analysis of open-ended questions and interview instrument part whereas data from *TVpre-Part2* and *TVpre-Part3* were examined quantitatively in statistical analysis for testing hypothesis part. *TVpost* consisted also from two parts. *TVPost-Part1* was given to experimental group students to answer three open-ended questions for obtaining students' evaluations about history of mathematics integrated lessons by personal declarations after the treatment. *TVpost-Part2* contains questions about the treatment topics which are the volume of pyramids, cones and spheres. Data obtained from *TVpost-Part1* were evaluated qualitatively while *TVpost-Part2* was evaluated in quantitatively. Quantitative and qualitative data analyses were carried out individually for each school. But, analysis of the *Interview Instrument* was conducted by considering selected students from School 1 and School 2 together.

The following sections include findings and related interpretations concerning the effects of history of mathematics integrated instructions on eight grade students' mathematics achievement and self-efficacy toward mathematics.

Hypothesis 1 was tested by independent sample t-test for indication if 8^{th} grade students who received instruction integrated with history of mathematics will have significantly higher scores on post measure (*Test-Volumet*) in comparison to those who received regular instruction on volume of pyramid, cone and sphere topics. It was found that, in School 2, there is statistically significant difference between the posttest scores of the experimental group and the control group students, so, the results support the hypothesis. It means that the treatment instruction integrated with history of mathematics was effective in terms of advancing students' achievement in mathematics; with t= 2,58; p= ,01 for School 2 with a moderate effect size (Cohen's d= .6). But, in School 1, although the mean score of the experimental group was higher than the control group, there is not any statistically significant difference between the posttest scores of the two groups. So the results did not support the hypothesis because the findings showed that the treatment instruction integrated with history of mathematics was not effective in terms of advancing students' achievement in mathematics. The participants reveal the scores as t= ,91; p= ,36 for School 1.

The reason for not observing the significant difference between posttest results of experimental and control group students in School 1 may depend on the timing of the study. The treatment topic was one of the last topics in last semester of 8^{th} grade. So, the study was implemented at the end of the term. Many of the students were preparing for national high school entrance exam (Seviye Belirleme Sınavı - SBS) during that period, and the school allowed them for not attending to school in the last month of the semester for studying at home. So, during administration of the posttest for this study, the majority of school exams had finished. Students in School 1 may be reluctant to complete the posttest, and also, because their priority was to receive high grades in SBS, they may not understand the benefits of history of mathematics integrated instructions. On the other hand, in School 2, students were not permitted for not attending to school for the last month and during the treatment, students continue to their courses. The exams in School 2 had not finished. So that, students in School 2 could more benefit from history of mathematics integrated instructions in terms of their comprehension levels.

Another reason behind this result may depend on the effect of a new teacher with a different format. The same situation occurred in both school but in School 2, the researcher attended the classes for two weeks with their teachers before the treatment lessons began. The students were acquainted with the researcher during this period. But, in School 1, again because the students were not at school in the last month of the semester, the treatment should be done as soon as possible. So, the researcher only attended two classes of students to meet them before the treatment lessons began. So the adaptation process for new experience with new teacher may affect their learning. Hence in posttest, the mathematics achievement of experimental group of School 1 who was treated with instruction integrated with mathematics history is not significantly different than the control group students who were treated with regular instruction.

The results obtained from the study for School 1 contradicted with the research of İdikut (2007) which showed that history of mathematics supported lessons were effective in terms of success in mathematics. Besides, there is a significant difference between the performance of group taught with instruction integrated with history of mathematics and the group with regular instruction without mentioning mathematics history of the related topic (Awosanya, 2001). Using history of mathematics in teaching mathematics makes it easy to understand and increase the mathematics performance. In addition, there are many studies (Carter, 2006; Cooke, 1997; Liu, 2003) which stated the power of integrating history of mathematics to mathematics instruction in increasing the mathematics performance. Also, Karaduman (2010) pointed out in his research that in classroom where differentiated curriculum was used where history of mathematics was utilized, math students understand the subject more easily. So, the effects of the instructions integrated with history of mathematics in this study may be inquired in the light of the timing of the study, the mood of study group and the effect of researcher as new teacher in the classroom. But, the findings of School 2 for the study represented that mathematics instruction integrated with related history affected students' mathematics achievement in a positive way in experimental group. So, the outcomes indicated that integrating the history of mathematics is an effective procedure in terms of increasing the mathematics success in the school where the study was carried out.

Hypothesis 2. was examined by independent sample t-test for indication if 8^{th} grade students who received instruction integrated with history of mathematics will have significantly higher scores in post measure of *Mathematics Self-efficacy Scale* in comparison to those who received regular instruction on volume of pyramid, cone and sphere topics. It was found that although the mean score of experimental groups were higher than the mean scores of control groups in both schools in post measure, there is not any statistically significant difference between the posttest scores of two groups in both schools. So, the results did not support the hypothesis because the findings showed that the treatment instruction integrated with history of mathematics was not effective in terms of advancing students' self-efficacy in mathematics. The participants reveal the scores as t= -,58; p= ,55 for School 1 and t= 1,73; p=,087 for School 2.

The reason for not observing the significant difference between posttest results of experimental and control group students in both schools may depend on many reasons. As it was stated before, one of them may be the reluctance of students to complete the scales because the study was implemented at the end of the second semester and many of their exams were passed over. Most of the students were in "graduate" mood. The feeling that the results of the scales would not affect their mathematics grades may also decrease their motivation during the study. Also, the duration of the study was only two weeks. It may be difficult to change the mathematics self-efficacy of students in this short period. What's more, during the post measure of self-efficacy, many students asked why they fill the *Mathematics Self-efficacy Scale* again. They may not accustomed to attend such studies beforehand and so their motivation during the filling the same scale second time may diminish.

The results obtained from the study for both schools contradicted with the research studies which indicated that history of mathematics integrated instruction increase positive feelings, self-confidence and attitudes of students toward mathematics (Awosanya, 2001; Fried, 2007; Liu, 2003; Savizi, 2006; Tözlüyurt, 2008). On the other hand, some of the studies found that history of mathematics integrated instruction do not have any effect in changing the attitudes of students toward mathematics (İdikut, 2007; Marshall, 2000). So, the effects of the instructions integrated with history of mathematics in this study may be questioned in the light of the timing of the study, the mood and motivation of study group.

As it is summarised there were some limitations as well as differences in the treatments which can not be controlled by the researcher, but also the results of the study showed that effects of instruction integrated with history of mathematics may change according to the context and the characteristics of the sample. Comparing with the control groups achievement levels, treatment was effective in one school where as in the other school it was not as effective as in the first one. In terms of changing the self-efficacy levels treatments did not bring any change.

Apart from testing 8th grade students' mathematics achievement and self-efficacy toward mathematics, the study also aimed to examine students' background on history of mathematics and their views about history of mathematics integrated lessons. With the intention of examining these reasons, as it mentioned before, descriptive statistics were used to analyze data obtained from *TVpre-Part1*, *TVpost-Part1* and *Interview Instrument* for both schools. All these instruments include open ended questions and require personal declaration for obtaining more in-depth data. The results get from these instruments were remarkable.

To start with, in the first question of *TVpre-Part1*, all experimental and control group students in both schools were asked if they learn any information about history of the topics they encounter during their mathematics lessons and if so, how they learned it. The second question was if they could give two examples of the topics about history of mathematics they remember. Students gave answer “yes” to the first question, 93.3 per cent, 86.6 per cent in experimental and control groups respectively in School 1; and 86.5 per cent, 67.5 per cent in experimental and control groups respectively in School 2, and they claimed that they learned history of the topics from their teachers or from their course books most frequently.

The responses to the second question showed that the answer categories of “geometry works of Atatürk” and “Pythagoras” were in prominence. Atatürk, who is both a familiar name for students, and who has actually written a geometry book, was remembered by a high percentage of the students. The other category which remembered mostly is “Pythagoras”. “Pythagoras correlation” was the name of a topic in 8^{th} grade mathematics curriculum (Aygün *et al.*, 2009, p. 80). High percentage of this answer category is again as expected because students had an opportunity to repeat the name of Pythagoras during that topic and also this study was carried out in 8^{th} grade just after the topic Pythagoras topic so that the probability to remember what they learned could be higher.

So, although most of the students answered “yes” to the first question about if they learn history of mathematics related with their mathematics topics during their lessons, they remember just few topics. This result could be because of shortage of integration of mathematics history parts to related topics in mathematics books. Parts about mathematics history appear like separate episodes in books only to read, apart from Atatürk’s geometry works and Pythagoras correlation. Many of the other topics are not incorporated to mathematics topics. As consistently with the literature, students could remember that they learn some information about history of topics during mathematics lessons but they could not even recall many of the names of history of mathematics parts. Studies support that history of mathematics could be more useful, if it is integrated into the topics related to it (Awosanya, 2001; Carter, 2006; Goodwin, 2007; İdikut, 2007; Liu, 2003; Marshall, 2000; Sassano, 1999; Tözlüyurt, 2008).

As it noticed before, *TVpost-Part1* instrument was implemented only to experimental group students in both schools. In the first question of *TVpost-Part1*, experimental group students were asked their thoughts about history of mathematics integrated lessons on treatment topics, the favorable and not favorable aspects of such lessons for them. The analyses of answer categories showed that students generally have favorable declarations about this kind of treatment. Many of the students in both schools declared that such kind of instructions were enjoyable and interesting with high percentages; 69 per cent and 64 per cent for category enjoyable; and 41 per cent and 45 per cent for category interesting in School 1 and School 2 respectively. Furthermore, the answers of increasing understanding and enabling learning the topic as well as the history of related topic were also given with high percentages by students. The number of students giving negative answers such as "long questions", "too many formulas", "boring", "no, I don't like", and "difficulties in construction problems" is considerably low in both groups when compared to positive answers. 21 per cent of the first group and 14 per cent of the second group only stated the answer "no, I don't like" without giving any explanation about its reason which means that although they gave answer "no" to this question they were not stated anything about treatments they don't like. As it can be inferred from the answers, students who were given instruction integrated with history of mathematics generally have positive thoughts toward such kind of instructions. The answers could be interpreted such that if students see the historical aspect of what they learned, then they believe mostly that mathematics is interesting and enjoyable and their understanding of it increased. As Liu (2003) proposed history can help increase motivation and helps develop a positive attitude toward mathematics.

In the second question, students were enquired to give answer to the question about how their learning was affected by history of mathematics integrated lessons. Students in both experimental groups described that their learning was influenced in a positive way from such lessons. Most of the students declared that they understand better, found the lessons more interesting and learned the subject matter and the related history together during lessons better. No one said that their learning was negatively affected during the treatments. Also, ten per cent of the first experimental group and six per cent of the second experimental group did not answer this question. This result may be regarded as an indicator for the consequence of using history of mathematics during instructions.

Last question of *Post-V-Part1* questioned students if the related history of mathematics parts of the subjects should be integrated to their next mathematics lessons too. Critically few students answered “no” to this question with reasoning “boring”. Many students responded that such instructions should be integrated to mathematics lessons by delivering reasons such as “better understanding”, “learning the origin of the topics”, enjoyable lessons” and “permanent knowledge”. As it can be inferred from all of the answers to the three questions of posttest, students generally agreed that history of mathematics instructions are effective in understanding, learning better and having more enjoyable and interesting lessons.

After the treatments, an *Interview Instrument* about students’ views on history of mathematics integrated instructions was implemented to totally 12 students from experimental groups of School 1 and School 2. The first question of this instrument was about what are the differences of the treatment lessons that were processed in this study from their lessons so far. Students’ perceptions on history of mathematics integrated lessons different than their standard lessons were most frequently about “learning the history of subjects”. As well, the categories like “making activities”, “visual lessons”, and “enjoyable lessons” have been confirmed with high percentages in both classes. Also, few students stated that the experimental lessons supplied them permanent knowledge with cultural background. In this research; historical anecdotes, short biographies, ancient problems were some of the means used where history of mathematics integrated to the curriculum At the end of such lessons, the answers of students illustrated that they claimed positive views about the treatment lessons.

For the answer to the second question, students gave diverse answers from history of mathematics of subject they learned during lessons. Nearly all of the parts about mathematics history which was mentioned during experimental lessons remembered by students; like Euclid-pyramids, Archimedes-example question, Archimedes-volume of sphere, Egypt pyramids, Archimedes - lifting force of water, Moscow Papyrus, Hourglass. The diversity of answer categories may be interpreted as; students found every historical part of the instruction interesting and worth to remember, not only one or two of them.

The third question of the *Interview Instrument* was about to specify students' views on which parts did mostly attracted their attention during history of mathematics integrated instructions. In fact this question was asked for the purpose of giving probability to highlight the difference of history of mathematics incorporated instructions. All of the answers being given by students were about the history of mathematics parts mentioned during the instructions. The frequency of the answer "Improvements in mathematics during history within limited facilities" was the highest in both of the experimental groups. This result is notable because students were affected by human-facet side of mathematics and improvements in mathematics. One of the main reasons of using history of mathematics in mathematics lessons was that the cultural understanding and replacement supported by history helps to humanize mathematics education (Furinghetti, 2007). Also, in mathematics classes, the materials developed by using history of mathematics can be engaging and meaningful in terms of understanding the other's perspective (Arcavi and Isoda, 2007).

Lastly, students were questioned about how was the effect of mathematics history integrated instruction on their mathematics learning and ideas about mathematics. The category "enjoyable" was the most frequent answer in both experimental groups. This result could be inferred as an indication that students have positive perceptions about mathematics lessons which were incorporated with history. This is consistent with the findings of Awosanya (2001) who stated that "history of mathematics changes pupils' perception of mathematics as a dull subject to a more interesting one". Also, Yevdokimov (2004) declared that in order to increase understanding of different ideas and the "whys" of the topics, mathematics history can help students. Again parallel with this idea, an apparent positive development was seen in category of "better understanding" which was answered frequently by 12 interviewees. So, the results obtained from the interview showed that students were generally profited from treatment lessons in terms of better learning, positive ideas toward mathematics, enjoyable instructions and learning the history of mathematics while learning the subject.

The results of quantitative data analyses showed that although the mean scores of the experimental group were higher than the control group in School 1 in terms of mathematics achievement on post measure (*TVpost-Part2*), there is not any staticstically significant difference between the posttest scores of both groups. But the results support the related hypothesis for School 2 which means that there is a statistically significant difference between the posttest scores of two group students. On the other hand, even though the mean scores of experimental group students were higher than the control group students on post measure of *Mathematics Self-efficacy Scale* in both schools, there is not any statistically significant difference on post scores of both groups. So, the related hypothesis was not supported. But, the results of open-ended questions and interview showed that experimental group students have generally positive views on the treatment lessons. They claimed that their mathematics lessons were more enjoyable by this way and also their learning was facilitated. Such kind of a consequence among students' answers support the significance of the curriculum connection of the history of mathematics integrated instruction.

7.1. Limitations

There were certain limitations of this study. First of all, it is not possible to generalize the results of the study to 8th grade students other than the students of two public schools participated in the study. The sample size is small and the participants of the study were not selected randomly. This study was carried on with 131 eight grade students. Convenient sampling was used while selecting the schools. Two classes from each school were attained to treatment groups randomly, one as control group and one as experimental group. Since the schools were not selected by using randomization techniques, the data obtained from each school were analyzed separately. So, all these conditions preclude any meaningful generalization of the results to all 8th grade students.

Another limitation could be the researcher's twofold role which may confuse students' mind, even though, both control and experimental group students were thought by the researcher. One other limitation could be the timing of the implementation. The participants of the study were 8th grade students who were preparing for the national secondary school entrance exam (Seviye Belirleme Sınavı - SBS). The study was carried out at the end of the second term. Although there was one more month to end the semester during implementing the treatment, one of the schools gave permission to its students for not coming to school after their exams were finished. So, during implementing the posttest, most of their school exams were over and they focused on their national placement exam. Therefore, many of them were not willing to do the tests, making the activities or answer the questionnaires. Moreover, the length of application time of treatments was only two weeks which was really short period especially in order to obtain an increase in the mathematics self-efficacy of students. All of these could decrease the efficiency of the study.

Students' expectation about the pretests and posttests may be one of the limitations also. Because students were conscious of the fact that the result of the scales would not affect their mathematics grades, their motivation toward lessons may decrease during the study. Also, self-efficacy scale includes general statements. It may be a limitation to assess students' self-efficacy in a detailed way.

To sum up, some of the limitations like researchers' role, timing of application, selection and limited number of participants, students' mood during the treatment were the main limitations of the study.

7.2. Recommendations for Further Research and Implications

The finding of the study show that even if the mean scores of the experimental group were higher than the control group in School 1 in terms of mathematics achievement on post measure (*TVpost-Part2*), there is not any statistically significant difference between the posttest scores of both groups. On the other hand, in School 2, there is a statistically significant difference between the posttest scores of two group students. So, the hypotheses were supported for School 2. Moreover, even though the mean scores of experimental group students were higher than the control group students on post measure of *Mathematics Self-efficacy Scale* in both schools, there is not any statistically significant difference on post scores of both groups. So, the findings of the study did not support the hypotheses. This could offer a feedback to make necessary adjustments for further studies and also the effectiveness could be improved with a better implementation in future research studies. Besides, lessons plans about instruction integrated with history of mathematics which were developed by the researcher could be used as a model in similar topics, in different grades. Also, qualitative instruments such as the open ended questions and *Interview Instrument* about examining the views of students on history of mathematics integrated instructions showed that students have positive declarations on such lessons, consistent with the general trend of other studies which are exploring the effects of history of mathematics integrated instructions. Hence, this tendency should be further explored.

A similar study may be conducted with different eight grade samples in order to obtain more general results. In order to decrease the limitation about researchers' dual role, the mathematics teachers of the sample groups could be included into the study and so, students may benefit more from the treatment instructions if they were in their real classroom environment with their mathematics teacher.

Some extra credits for their works and performances could be given to students for increasing their interest towards completing the pretests, posttests or giving answers to interviews. Their enthusiasm may increase if they know that their pretests or posttests will be scored and they will get extra grades from these tests. Moreover, a retention test may be administered after a period of time to the groups in order to investigate if there was any difference in the experimental and control groups in terms of recall levels of the treatment topics.

In addition, to increase the impact of the treatments, the works or contributions of Turkish mathematicians throughout the history could be added to lesson plans. This familiarity may also attract students' attention and their attitudes towards mathematics history integrated instructions may change. Teachers and researchers might also adjust the math lessons by searching other historical practices.

For further research it can be suggested to find mathematics teachers' views on integrating history of mathematics to their instruction. If differences of teachers' views on history of mathematics integrated instructions could effect on how they teach mathematics, hence, if it will shape the way students perceive and understand mathematics would be worthy of study. As stated by Philippou and Christou (1998), teachers' mathematics conceptions and their self-perceived relationship to mathematics have considerable influence in the formation of their learning and teaching performance.

APPENDIX A: SAMPLE PARTS ABOUT HISTORY OF MATHEMATICS IN MIDDLE GRADE TEXT BOOKS

Tarih Köşesi

1900'lü yıllarda İngiliz istatistikçi Karl Pearson (Karl Piırsın) bir madenî parayı 24 000 defa fırlattı ve 12 012 defasında tura geldi. 2. Dünya Savaşı boyunca John Kerrich ve arkadaşları yine bir madenî parayı 10 000 defa fırlattılar. Sonuçları aşağıdaki tabloda verilmiştir.

Fırlatma Sayısı	Tura Gelme Sayısı	Yaklaşık Sıklık
10	4	0,400
50	25	0,500
100	44	0,440
500	255	0,510
1000	502	0,502
5000	2533	0,507
8000	4034	0,504
10 000	5067	0,507

Veriler hakkındaki düşüncelerinizi açıklayan kısa bir yazı yazınız.

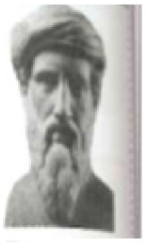
Tarih Köşesi

1742 yılında Christian Goldbach (Kristin Goldbah)'ın Leonard Euler (Leonard Öyler)'e yazdığı mektupta garip bir tahmin yer alıyordu. Bu da her çift sayının iki asal sayının toplamı şeklinde yazılabilir olduğu idi. (4=2+2, 8=5+3 vb.)

Yapılan denemelerle doğrulanan bu düşünce henüz kanıtlanamadı. Bu düşünceyi doğrulayacak 20 örnek bulabilir misiniz?

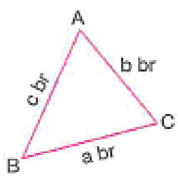
Biliyor musunuz?

Pythagoras (Pisagor) matematik, astronomi ve müzik alanında önemli bilimsel çalışmalar yapmış Yunanlı bir filozoftur. M.Ö. 500'lü yıllarda güney sahillerimize yakın olan Sisam adlı Yunan adasında doğduğu tahmin edilmektedir. Mısır ve Babil filozoflarından aldığı eğitimle İtalya'da çalışmalarına devam etmiştir.



Biliyor musunuz?

Mısırlı bir bilim adamı olan Heron'un mekanik alanda ve geometri alanında önemli çalışmaları olmuştur. Heron, kenar uzunlukları a br, b br ve c br olan bir ABC üçgeninde $u = \frac{a+b+c}{2}$ olmak üzere $Alan(\widehat{ABC}) = \sqrt{u.(u-a).(u-b).(u-c)}$ olduğunu göstermiştir.



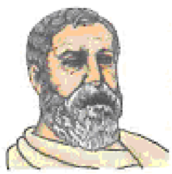


Figure A.1. Examples about history of mathematics related parts from middle grade text boks (MEB, 2009).

APPENDIX B: TEST- VOLUME-pre (TVpre) INCLUDED

TVpre-Part1, TVpre-Part2 and TVpre-Part3

Hacim Kavramı Testi -1

TVpre-Part1

1. Matematik dersleriniz sırasında işlediğiniz konunun tarihi ile ilgili bilgiler öğreniyor musunuz?

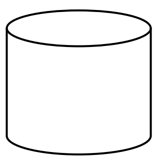
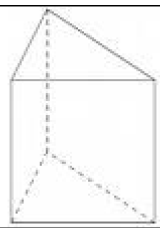
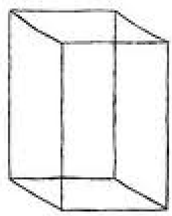
   Öğreniyorsanız;

   a) nasıl? (Kitaptan okuyarak, Öğretmen anlatıyor, vb.)
   ……………………………………………………………………………………………
   ……………………………………………………………………………………………
   ……………………………………………………………………………………………
   ………………………

   b) hatırladığınız matematik tarihi ile ilgili konulara iki örnek verir misiniz?
   ……………………………………………………………………………………………
   ……………………………………………………………………………………………
   ……………………………………………………………………………………………

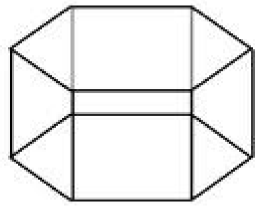
TVpost-Part2

2. Aşağıdaki tablodaki geometrik şekillerle ilgili boş kısımları doldurunuz.

			
Şeklin adı			
Taban şekli			
Taban alanı			

3. Aşağıdaki altıgen dik prizmanın temel elemanlarına **a** seçeneğindeki gibi birer örnek veriniz.

a. Yükseklik= …[EK]………



b. Yanal ayrıt = …………

c. Taban =………………..

d. Yanal yüz =...…………

e. Taban ayrıtı =…………

4.a. Dik prizmanın hacim bağıntısını formül kullanmadan bir cümle halinde açıklayınız.

………………………………………………………………………………………..………

……………………………………………………………………….............................

b. Dik dairesel silindirin hacim bağıntısını formül kullanmadan bir cümle halinde açıklayınız.

………………………………………………………………………………………..………

…………………………………………………………………………………………..

5.a. Taban uzunluklarından biri **a**, yüksekliği **h** olan bir eşkenar üçgen dik prizmanın hacmini formül şeklinde yazınız.

………………………………………………………………………………………..………

…………………………………………………………………………………………..

b. Taban uzunluğu **a**, yüksekliği **b** olan bir dik kare prizmanın hacmini formül şeklinde yazınız.

…………………………………………………………………………………………..

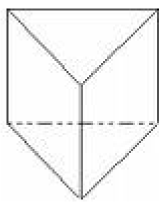
…………………………………………………………………………………………..

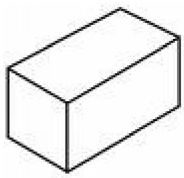
c. Yarıçapı **r**, yüksekliği **h** olan bir dik silindirin hacmini formül şeklinde yazınız.

…………………………………………………………………………………………………..

…………………………………………………………………………………………………..

6. Aşağıda verilen şekillerin hacimlerini bulup altlarındaki boşluklara yazınız.

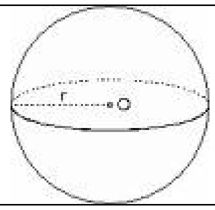
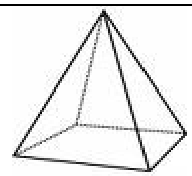
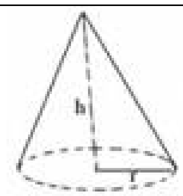




V=…….. V=……….. V=………

TVpre-Part3

7. Aşağıdaki tabloda gösterilen geometrik şekillerle ilgili boş kısımları doldurunuz.

			
Taban alanı			
Yükseklik			
Hacim			

8. Aşağıdaki ifadelerden doğru olanların yanına **(D)**, yanlış olanların yanına **(Y)** yazınız.

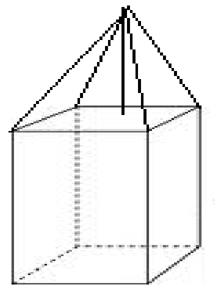
( ) Yarıçapları aynı olan bir silindir ile kürenin hacimleri oranı 2/3 tür.

( ) Yüksekliği aynı kalmak koşuluyla hacmi yarıya düşen bir dik koninin taban yarıçapı da yarıya düşer.

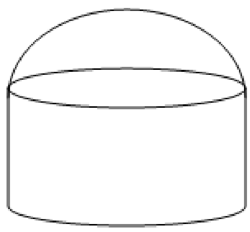
( ) Bir kare piramidin hacmi; tabanı ve yüksekliği bu piramidin tabanı ve yüksekliğine eşit olan bir kare prizmanın hacminin üçte birine eşittir.

( ) Konilerin hacim formülünden yararlanarak kürenin hacmini hesaplayabiliriz.

9. a. Aşağıda verilen şeklin hangi geometrik cisimlerden oluştuğunu altına yazınız ve verilen değerleri kullanarak bu şeklin hacmini bulunuz.



b. Aşağıda verilen şeklin hangi geometrik cisimlerden oluştuğunu altına yazınız ve verilen değerleri kullanarak bu şeklin hacmini bulunuz.



10. Aşağıdaki cümlelerdeki boşlukları doldurunuz.

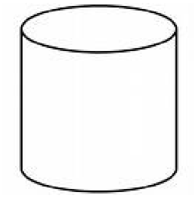
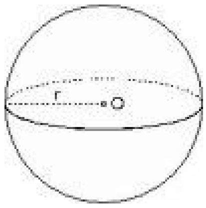
a. Yükseklikleri aynı olan koni ve piramidin hacim bağıntılarının aynı olmasına rağmen sonucun farklı olmasının sebebi …………………………………………..dır.

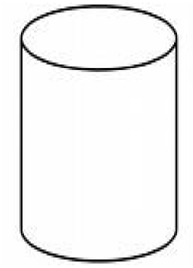
b. Bir dik koninin hacmi tabanı ve yüksekliği bu koninin tabanı ve yüksekliğine eş olan dik silindirin hacminin ………………………….. kadardır.

c. Yarıçapları oranı 2/5 olan kürelerin hacimleri oranı ………………….olur.

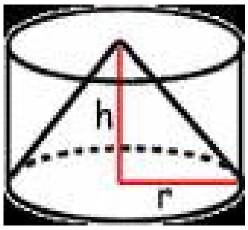
d. Taban ayrıtları 2 katına çıkıp, yüksekliği yarıya inen kare dik piramidin hacmi ………………… katına çıkar.

11. Aşağıda taban yarıçapları ve yükseklikleri verilen dik dairesel koni, küre ve dik silindirlerden **hacimleri birbirine eşit** olanları eşleştiriniz.

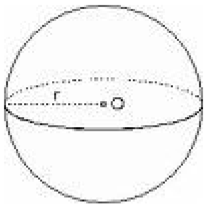



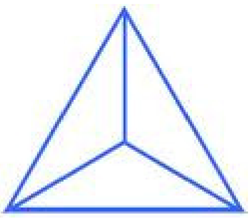
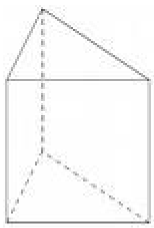
12. Aşağıdaki şekilde **tabanları çakışık, yükseklikleri eşit** bir koni ve bir silindir verilmiştir. Silindir ile koninin arasındaki boşluğun hacmi 48 cm^3 olduğuna göre koninin hacmi kaç cm^3 tür?



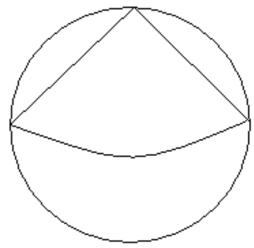
13. En büyük dairesinin alanı 108 cm^2 olan kürenin hacmi kaç cm^3 tür? ($\prod$ =3)



14. Üçgen dik **piramidin** yüksekliği, hacmi 100 cm^3 olan üçgen dik **prizmanın** yüksekliğinin 3 katıdır. Bu cisimlerin tabanları eş ise üçgen dik piramidin hacmi kaç cm^3 tür?

14. Tabanı kürenin en büyük dairesi olan ve tepesi kürenin üzerinde olan en büyük koninin hacmi 8 cm^3 tür. Bu koniyi içeren kürenin hacmi kaç cm^3 tür? ($\prod$ = 3)



15. a= 4 cm.,   h= 6 cm.
Yukarıdaki verileri kullanarak **dik piramidin hacmi** ile ilgili şekil çizerek çözülebilecek bir problem kurunuz ve çözünüz.

16. Top, 16 cm., hacim verilerini kullanarak bir problem kurunuz ve çözünüz.

APPENDIX C: TEST- VOLUME-post (TVpost) INCLUDED TVpost-Part1 and TVpost-Part2

Hacim Kavramı Testi - 2
TVpost-Part1

1. "Piramitlerin, koninin ve kürenin hacmi" ile ilgili matematik tarihiyle desteklenmiş dersler hakkındaki düşünceleriniz nelerdir?
   Hoşunuza giden yönler nelerdir? Nedenleri?
   …………………………………………………………………………………………
   …………………………………………………………………………………………
   ………………………………………………………………………………………....

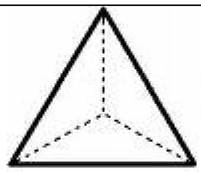
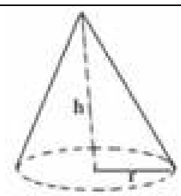
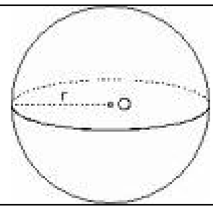
   Hoşunuza gitmeyen yönler nelerdir? Nedenleri?
   …………………………………………………………………………………………
   …………………………………………………………………………………………
   ………………………………………………………………………………………....

2. Ders sırasında ilgili konunun matematik tarihinden bahsedilmesinin öğrenmen üzerindeki etkileri nasıl oldu?
   …………………………………………………………………………………………
   …………………………………………………………………………………………
   ………………………………………………………………………………………....

3. Bundan sonraki matematik derslerine de matematik tarihi ile ilgili kısımlar dahil edilmeli mi? Neden?
   …………………………………………………………………………………………
   …………………………………………………………………………………………
   ………………………………………………………………………………………....

TVpost-Part2

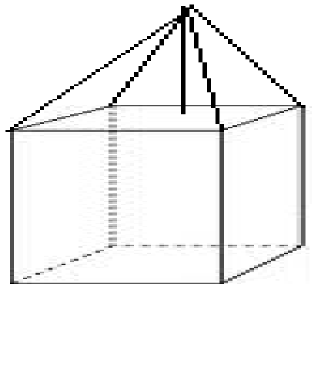
4. Aşağıdaki tablodaki geometrik şekillerle ilgili boş kısımları doldurunuz.

			
Taban alanı			
Yükseklik			
Hacim			

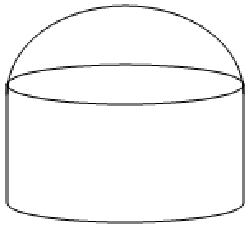
5. Aşağıdaki ifadelerden doğru olanların yanına (D), yanlış olanların yanına (Y) yazınız.

   a. (   ) Hacimleri oranı 27/125 olan kürelerin yarıçapları oranı 9/25 tir.
   b. (   ) Taban alanları ve hacimleri aynı olan bir üçgen piramit ile üçgen prizma karşılaştırıldığında; piramidin yüksekliğinin prizmanın yüksekliğine oranının 3 olduğu sonucuna varılır.
   c. (   ) Bir dik koninin hacmi; tabanı ve yüksekliği bu koninin tabanı ve yüksekliğine eşit olan bir silindirin hacminin üçte birine eşittir.
   d. (   ) Piramitlerin hacim formülünden yararlanarak kürenin hacmini hesaplayabiliriz.

6. a. Aşağıda verilen şekillerin hangi geometrik cisimlerden oluştuğunu altlarına yazınız



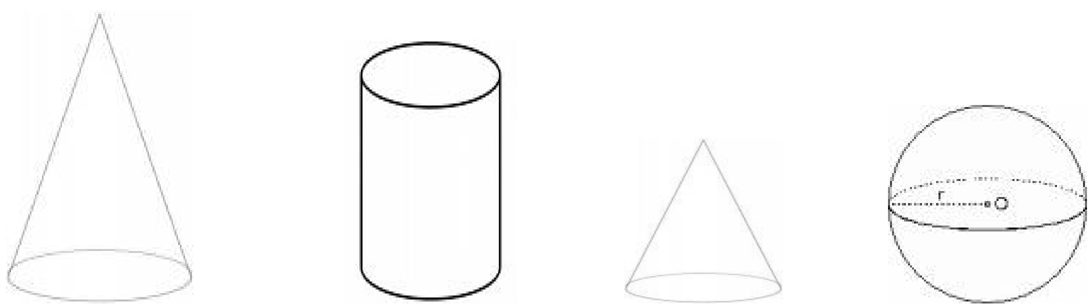
b. Verilen değerleri kullanarak bu geometrik cisimlerin hacimlerini bulunuz.



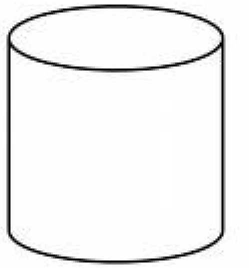
7. Aşağıdaki cümlelerdeki boşlukları doldurunuz.

   a. Yükseklikleri aynı olan koni ve piramidin hacminin [(taban alanı×yükseklik) / 3] formülü kullanılarak bulunmasına rağmen sonucun farklı olmasının sebebi …………………………………………..dır.
   b. Bir piramidin yüksekliği 3 katına çıkarıldığında hacmi ………………… katına çıkar.
   c. En büyük çemberinin yarıçap uzunluğu r olan bir kürenin hacmi, taban yarıçapı r ve yüksekliği 2r olan dik silindirin hacminin …………………………eşittir.
   d. Bir dik koninin taban yarıçapı 4 katına çıkarılırsa, hacmi ………………………..katına çıkar.

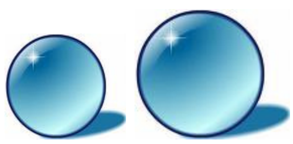
8. Aşağıda taban yarıçapları ve yükseklikleri verilen dik dairesel koni, küre ve dik silindirlerden hacimleri birbirine eşit olanları eşleştiriniz.

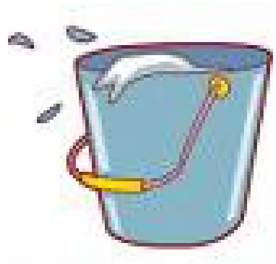


9. İçi su dolu dik dairesel koni şeklindeki bir kabın yüksekliği 24 cm.dir. Kabın içindeki su, dik silindir şeklinde başka bir kaba boşaltıldığında suyun yüksekliği kaç cm. olur? Yukarıdaki problemin çözülebilmesi için eksik olan veriyi tamamlayınız. Buna göre problemi çözünüz.

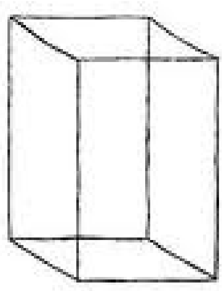


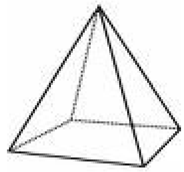
10. Yarıçapı 3 cm, ve 5cm olan içi dolu metal iki küre; içi tamamen su dolu bir kovanın içine atılıyor. Kürelerin taşırdığı suyun hacmi kaç cm^3 tür?



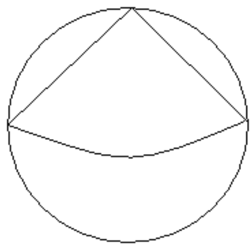


11. Hacmi 150 cm^3 olan kare dik prizmanın yüksekliği, kare dik piramidin yüksekliğinin 1/3 idir. Bu cisimlerin tabanları eş ise kare dik piramidin hacmi kaç cm^3 tür?





12. Tabanı kürenin en büyük dairesi olan ve tepesi kürenin üzerinde olan en büyük koninin hacmi 27 cm^3 tür. Bu koniyi içeren kürenin hacmi kaç cm^3 tür?



13. **r = 5 cm., h = 8 cm.**

Yukarıdaki verileri kullanarak dik koninin hacmi ile ilgili şekil çizilerek çözülebilecek bir problem kurunuz ve çözünüz.

14. **portakal, 6 cm., yarıçap, hacim**

Verilerini kullanarak küre ile ilgili bir problem kurunuz ve çözünüz.

APPENDIX D: SELF-EFFICACY TOWARDS MATHEMATICS SCALE

MATEMATİĞE YÖNELİK ÖZYETERLİLİK ÖLÇEĞİ

Sevgili öğrenciler, bu ölçek sizin matematik dersine ilişkin görüşlerinizi almak amacıyla hazırlanmıştır. Bu ölçek araştırma amaçlıdır. Verdiğiniz cevaplar gizli tutulacaktır. Her bir tutum cümlesi için sadece bir cevap işaretleyiniz. Hiç bir cümleyi cevapsız bırakmayınız. İçtenlik ve samimiyetle cevapladığınız her bir cümleyle araştırma tezime vermiş olduğunuz destekten dolayı çok teşekkürler.

		1. Hiçbir zaman	2. Ender olarak	3. Bazen	4. Çoğu zaman	5. Her zaman
1	Matematiği günlük yaşamımda etkin olarak kullanabildiğimi düşünüyorum.					
2	Günümü/zamanımı planlarken matematiksel düşünürüm.					
3	Matematiğin benim için uygun bir uğraş olmadığını düşünüyorum.					
4	Matematikte problem çözme konusunda kendimi yeterli hissediyorum.					
5	Yeterince uğraşırsam her türlü matematik problemini çözebilirim.					
6	Problem çözerken yanlış adımlar atıyorum duygusu taşırım.					
7	Problem çözerken beklenmedik bir durumla karşılaştığımda telaşa kapılırım.					
8	Matematiksel yapılar ve teoremler içinde dolaşıp yeni, küçük keşifler yapabilirim.					
9	Matematikte yeni bir durumla karşılaştığımda nasıl davranmam gerektiğini bilirim.					
10	Matematiğe çevremdekiler kadar hakim olmanın benim için imkânsız olduğuna inanırım.					
11	Problem çözmekle geçirdiğim zamanların büyük bölümünü kayıp olarak görüyorum.					
12	Matematik çalışırken kendime olan güvenimin azaldığını fark ediyorum.					
13	Matematikle ilgili sorunlarında çevremdekilere kolaylıkla yardım edebilirim.					
14	Yaşam içindeki her türlü probleme matematiksel yaklaşımla çözüm önerileri getirebilirim.					

APPENDIX E: INTERVIEW INSTRUMENT

1. What are the differences of the lessons we have processed together from lessons so far?
(Birlikte işlediğimiz derslerin şimdiye kadarki matematik derslerinden farkları nelerdir?)

2. What do you remember from history of mathematics parts of subjects you learned during lessons? Explain by giving two examples.
(Derste işlenen konunun matematik tarihi ile ilgili olan kısımlarından neler hatırlıyorsunuz? İki örnek vererek açıklayınız.)

3. Which parts did mostly attracted your attention during history of mathematics integrated instructions?
(Matematik tarihi dahil edilerek işlenen derslerde en çok ilginizi çeken kısımlar hangileriydi?)

4. How was the effect of such instruction on your mathematics learning and ideas about mathematics?
(Bu tür bir dersin, matematik öğrenmeniz ve matematik hakkındaki düşünceleriniz üzerinde nasıl bir etkisi oldu?)

APPENDIX F: THE OBJECTIVES OF “VOLUME OF PYRAMID, CONE AND SPHERE TOPICS IN CHAPTER 5 OF 8TH GRADE MATHEMATICS CURRICULUM

Students will;

1. create the volume formula of right pyramid.
2. create the volume formula of right circular cone.
3. create the volume formula of sphere.
4. solve and establish problems about the volumes of geometric objects.
5. predict the volumes of geometric objects by using strategy.

Öğrenciler;

1. dik piramidin hacim bağıntısını oluşturur.
2. dik dairesel koninin hacim bağıntısını oluşturur.
3. kürenin hacim bağıntısını oluşturur.
4. geometrik cisimlerin hacimleri ile ilgili problemleri çözer ve kurar.
5. geometrik cisimlerin hacimlerini strateji kullanarak tahmin eder.

APPENDIX G: REGULAR INSTRUCTION – LESSON PLAN

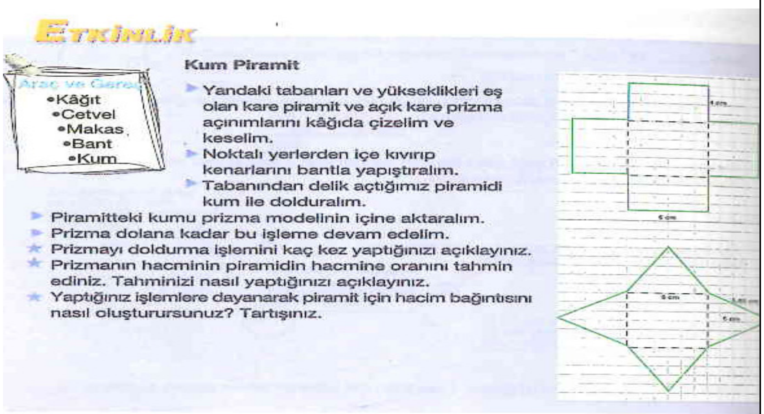
<table>
<tr><td>Öğretmen: Özlem ALBAYRAK</td><td>Sınıf seviyesi: 8
Ders: Matematik</td><td>Ünite 5: Geometrik Cisimlerde Ölçme ve Perspektif</td><td>Tarih: May 2010
Süre: 3 ders saati</td></tr>
<tr><td>Konu – Alt konu:
• Geometrik Cisimlerin Hacimleri
o Dik Piramidin Hacmi</td><td>Kazanımlar:
1. Dik piramidin hacim bağıntısını oluşturur.
2. Geometrik cisimlerin hacimleri ile ilgili problemleri çözer ve kurar.</td><td colspan="2">Araç ve Gereç: kağıt, cetvel, makas, bant, kum

Ekler: (Ek#1)</td></tr>
<tr><td colspan="4">Ön koşullar:
• Prizmalarda taban, yükseklik gibi kavramları şekil üzerinde gösterebilme
• Prizmaların tabanlarına göre isimlendirildiklerini bilme
• Prizmaların hacim bağıntılarını bilme
• Prizmaların hacim bağıntılarını kullanabilme</td></tr>
<tr><td colspan="4">Öğretici Aktiviteler- 1. ders</td></tr>
<tr><td>Zaman</td><td colspan="3">Ders</td></tr>
<tr><td>15 dakika</td><td colspan="3">Piramitlerin hacmini anlamak için gerekli olan önkoşul bilgiler şu şekilde pekiştirilir:

Öğrencilere verilmiş olan “Pretest- Volume” (TVpre) de uygulama konularıyla ilgili önkoşul bilgileri sorgulayan soruların olduğu ikinci kısımdan piramitlerle ilgili önkoşulu olan sorular sınıfta cevaplandırılır. Böylece öğrenciler piramitlerin hacmini öğrenebilmek için gerekli olan prizmaların hacim bağıntısı, hacim formülü, prizmaların temel elemanları ve verilen değerlerle prizmaların hacmini bulma ile ilgili önbilgilerini pekiştirmiş olurlar.</td></tr>
</table>

<table>
<tr>
<td></td>
<td>Öğretmen her soru için istekli bir öğrenciyi tahtaya kaldırır ve ilgili sorular çözülür. Bu yolla tüm sınıfın eksik bilgilerini gidermeleri sağlanır.</td>
</tr>
<tr>
<td>10 dakika</td>
<td>Aşağıdaki metin ve resim sunum şeklinde ekrana yansıtılır. Ekrandaki metin okutularak sorunun cevabıyla ilgili sınıfta bir tartışma ortamı oluşturulur.
Bu yapının hacmini hesaplayabilmek için dik piramidin hacim bağıntısına ihtiyaç olduğu hissettirilir. Bu bağıntıyı oluşturmak için de prizmaların hacim bağıntısından nasıl yararlanılabileceği sorulur.

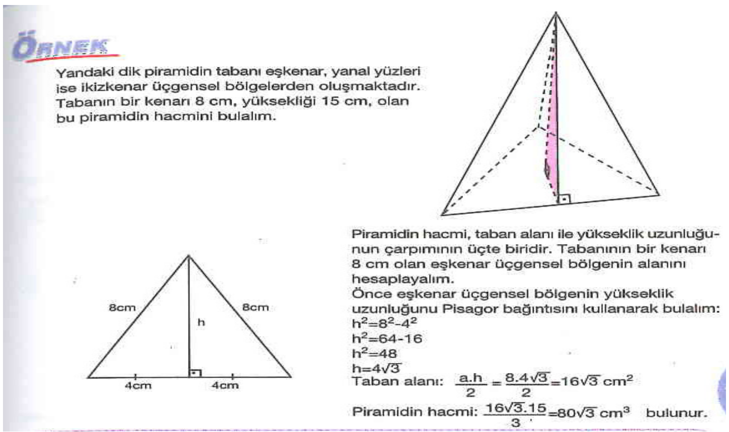

Ülkemizin kongre ve fuar merkezlerinden biri, Antalya'daki Cam Piramit Kongre ve Fuar Merkezi'dir. Renkli ısıcamlı uzay çatı ile örülerek piramit şeklinde inşa edilmiştir. 4500 m^2 taban alanına sahip olan bu yapının yerden yüksekliği 22,76 metredir. Piramit şeklindeki bu yapının hacmi yaklaşık olarak kaç metreküptür?</td>
</tr>
<tr>
<td>15 dakika</td>
<td>Öğrencilere aşağıdaki “Kum Piramit” adlı etkinlik yaptırılır. Bu sayede öğrencilerin dik piramidin hacim bağıntısını oluşturabilmeleri ve dik piramidin hacmini strateji kullanarak tahmin edebilmeleri amaçlanmıştır. Öğrenciler sıra arkadaşlarıyla grup halinde çalışırlar.


ETKİNLİK
Araç ve Gereç
•Kâğıt
•Cetvel
•Makas
•Bant
•Kum
Kum Piramit
► Yandaki tabanları ve yükseklikleri eş olan kare piramit ve açık kare prizma açınımlarını kâğıda çizelim ve keselim.
► Noktalı yerlerden içe kıvırıp kenarlarını bantla yapıştıralım.
► Tabanından delik açtığımız piramidi kum ile dolduralım.
► Piramitteki kumu prizma modelinin içine aktaralım.
► Prizma dolana kadar bu işleme devam edelim.
★ Prizmayı doldurma işlemini kaç kez yaptığınızı açıklayınız.
★ Prizmanın hacminin piramidin hacmine oranını tahmin ediniz. Tahminizi nasıl yaptığınızı açıklayınız.
★ Yaptığınız işlemlere dayanarak piramit için hacim bağıntısını nasıl oluşturursunuz? Tartışınız.</td>
</tr>
</table>

Ölçme : Öğretmen öğrenciler gerekli önkoşul bilgilerini cevaplarken sınıf içinde gezinir ve öğrencilerin cevaplarını kontrol eder. Anlamadıkları yerler ya da soruları olursa öğrencilere birebir yardımcı olur. Her soru tahtada cevaplandıktan sonra özet bir cümle kurarak cevabı pekiştirir.

<table>
<tr><td colspan="2">Öğretmen derse hazırlık etkinliği sırasındaki sunum ve soruları ve piramidin hacmiyle ilgili problemin cevabıyla ilgili tartışmayı yönlendirir, öğrencilerin katılımını sağlar.

Kum piramit etkinliğinde öğrencilerin sıra arkadaşlarıyla grup halinde çalışması takip edilir. Öğretmen etkinlik sırasında sınıf içerisinde gezinir ve ilgili soruları cevaplandırır.</td></tr>
<tr><td colspan="2">Öğretici Aktiviteler- 2. Ders</td></tr>
<tr><td>Zaman</td><td>Ders</td></tr>
<tr><td>15 dakika</td><td>Kum piramit etkinliğine devam edilir. Öğrencilerden prizmanın hacmini piramidin hacmine oranını tahmin etmeleri ve bu tahminlerini sınıfa açıklamaları istenir. Piramidin hacim bağıntısıyla ilgili sınıfta tartışma ortamı oluşturulur ve gruplar fikirlerini paylaşırlar.</td></tr>
<tr><td>10 dakika</td><td>Aşağıdaki örnek soru sınıfa inceletilir. Piramidin hacminin bulunuşu bir örnek üzerinde görülür. Öğretmen sorunun adımlarını tahtadan anlatır.



Bu etkinlik ve örnekten sonra öğretmen öğrencilerin buldukları aşağıdaki bağıntıyı özet şeklinde tekrar eder.
Dik piramidin hacmi, eş tabana ve eş yüksekliğe sahip dikdörtgenler prizmasının hacminin üçte biridir.
Dik piramidin hacmi :
(Taban alanı x Yükseklik) / 3</td></tr>
</table>

<table>
<tr>
<td>15 dakika</td>
<td>
Problem Çözelim Kuralım etkinliği yaptırılır.

Problem Çözelim ve Kuralım

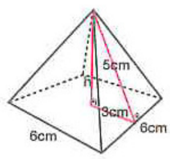
Kare dik piramit şeklinde, yan yüz yüksekliğinin yarısına kadar kapakla örtülmüş bir parfüm şişesi tasarlanmıştır. Şişe tabanının bir kenarı 6 cm, yan yüz yüksekliği ise 5 cm'dir. Kapak tabanına kadar dolu olan bu şişenin kaç mililitre parfüm alabileceğini bulalım.

Problemi Anlayalım
Yan yüz yüksekliği 5 cm, tabanının bir kenarı ise 6 cm olan kare dik piramit şeklindeki parfüm şişesi verilmiş. Şişe yüksekliğinin yarısı kapakla örtülü, diğer yarısı ise parfümle doludur. Bu şişenin kaç mL parfüm alacağını bulmamız isteniyor.

Öğrencilere bu problemi çözmeleri için nasıl bir plan takip edecekleri sorulur. Sınıfta bir tartışma ortamı yaratılır. Bu planlarını yazmaları ve ders sırasında uygulamaları istenir. Öğrenciler problemi çözdüğünde problemin aşağındaki cevabı tahtaya yansıtılır, bu cevap gönüllü bir öğrenci tarafından sınıfa açıklanır ve öğrencilerden cevaplarını kontrol etmeleri istenir.

Plan Yapalım
Önce dik piramidin yükseklik uzunluğunu bulup hacmini hesaplamalıyız. Daha sonra kapak kısmının ölçülerini bulup hacmini hesaplamalıyız. Hesapladığımız bu iki değerin farkını alıp parfümün hacmini mL cinsinden buluruz.

Planı Uygulayalım
Pisagor bağıntısı kullanıldığında yükseklik uzunluğu: $h^2 = 5^2 - 3^2$
$h^2 = 16$
$h = 4$ cm bulunur.



Piramidin hacmi: $\frac{\text{taban alanı x yükseklik}}{3} = \frac{6.6.4}{3} = 48$ c

Piramit yan yüksekliğine kadar kapakla örtülü olduğundar tabanının bir kenarı 3 cm, yüksekliği ise 2 cm'dir.

Kapağın hacmi: $\frac{3.3.2}{3} = 6\ cm^3$

Parfüm şişesinin hacmi: $48 - 6 = 42\ cm^3$ tür.
Şişe, $42\ cm^3 = 0{,}042\ dm^3 = 0{,}042L = 42$ mL parfüm alır.

Kontrol Edelim
Problemi tekrar okuyarak verilen çözümü kontrol ediniz.
</td>
</tr>
<tr>
<td colspan="2">
Ölçme : Öğretmen sınıf içi tartışmayı yönlendirir ve öğrencilerin katılımını sağlar.

Öğretmen öğrenciler problem üzerinde çalışırken sınıf içinde gezinir ve öğrencilerle ilgilenir. Anlamadıkları yerler ya da soruları olursa öğrencilere birebir yardımcı olur.
</td>
</tr>
<tr>
<td colspan="2">Öğretici Aktiviteler- 3. ders</td>
</tr>
<tr>
<td>Zaman</td>
<td>Ders</td>
</tr>
</table>

15 dakika	Öğrencilerden dik piramidin hacmi ile ilgili şekil çizilerek çözülebilecek bir problem kurmaları ve çözmeleri beklenir. Bu soruyla öğrencilerin kendilerinin bir problem oluşturması ve daha sonra bunu çözmeleri amaçlanmıştır. Soruyu çözdükten sonra her öğrenci soru ve cevabını yanındaki sıra arkadaşıyla değiştirir ve arkadaşının problemini kontrol eder. Cevabın yanlış olduğunu düşündüklerinde arkadaşıyla birlikte sorunun cevabı üzerinde tekrar düşünürler ve anlamadıkları yer olursa öğretmene sorarlar.
25 dakika	Bu kısımdan sonra uygulama sorularına geçilmektedir. Uygulama soruları öğrencilerin bu konuyla ilgiliöğrendikleri problemlerden oluşmuştur. Uygulama soruları ders saatinde çözülmeye başlanır (Ek#1) Ders süresinde yetişmeyen sorular eve ödev verilir. Daha sonra doğruluğu kontrol edilir.
Ölçme : Öğretmen öğrenciler problem üzerinde çalışırken sınıf içinde gezinir ve öğrencilerle ilgilenir. Anlamadıkları yerler ya da soruları olursa öğrencilere birebir yardımcı olur. **Öğretmenin uygulama soruları sırasında öğrencilerin aralarında gezmesi ve onlara yardımcı olması, kimlerin ne kadar anladıklarını ölçmesi açısından önemlidir. Her öğrenci çözme hızı ve seviyesine göre soruları çözer. Kalan soruların ev ödevi olarak çözülmesi istenir. Böylece, daha yavaş çözebilen ya da daha yavaş anlayan öğrenciler evde vakit ayırarak diğer arkadaşlarına yetişebilirler.**	

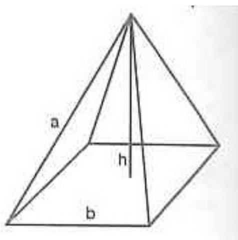
Ek#1: Piramidin Hacmi ile İlgili Uygulama (MEB, 2009)

1. Tabanı düzgün altıgensel bölgeden oluşan dik piramidinin cisim yüksekliği 10 cm ve bir kenarının uzunluğu 5 cm olduğuna göre hacminin kaç santimetreküp olduğunu bulunuz.

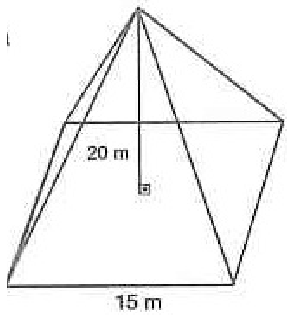
2. Bir dik kare piramidin yüzey alanı 192 cm^2, taban alanı 144 cm^2 ise hacmini bulunuz.

3. Yükseklik uzunluğu tabanının bir kenarının uzunluğunun üç katı olan kare dik piramidin hacmini harfli ifadeler kullanarak yazınız.

4. Dikdörtgen dik piramidin boyutları, a=3,8 cm, b= 6,3 cm, h=9,1 cm’dir. Bu piramidin hacmini tahmin ediniz. Tahmini bulduğunuz sonuçla karşılaştırınız.



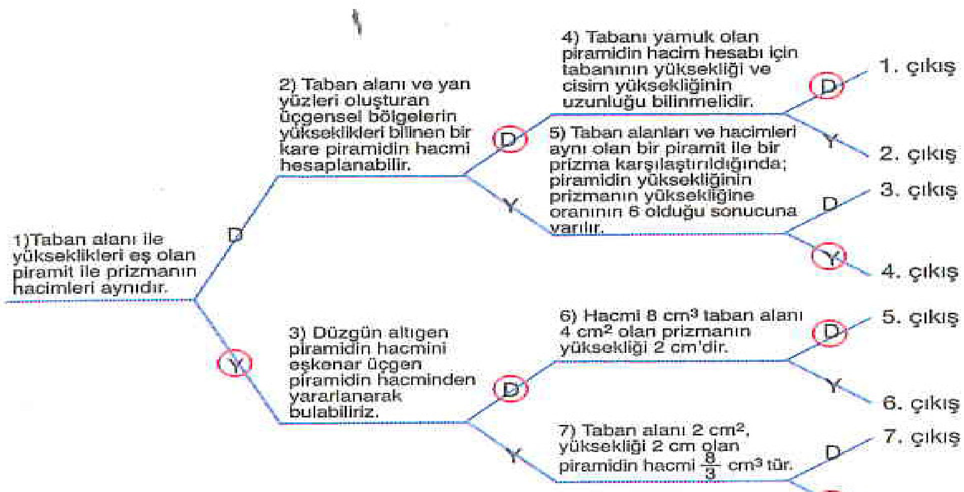
5. Aşağıdaki şekilde verilen kare dik piramit şeklindeki depoya 300 m^3 buğday konulduğunda deponun yarısı dolmuştur. Depoda daha önce kaç metreküp buğday vardır?



6. Aşağıdaki değerleri ve kelimeleri kullanarak bir problem kurunuz ve çözünüz.

   a= 6 m.
   b= 8 m.

7. Aşağıda birbiriyle bağlantılı doğru / yanlış cümleler verilmiştir. Şemadaki cümlelerde doğru olduğu belirtilen yargı yanlış, yanlış olduğu belirtilen yargı doğru olabilir. Her bir doğru / yanlış kararı sizi farklı çıkışlara ulaştırır ve alacağınız puanı etkiler. Buna göre aşağıdaki çıkışlardan birine ulaşınız.



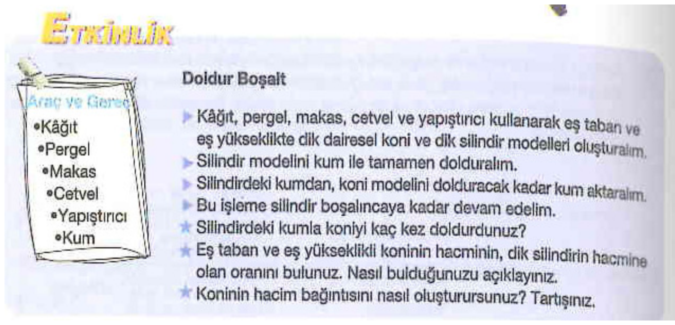
<table>
<tr><td>Öğretmen:
Özlem ALBAYRAK</td><td>Sınıf seviyesi: 8
Ders: Matematik</td><td>Ünite 5: Geometrik Cisimlerde Ölçme ve Perspektif</td><td>Tarih: May 2010
Süre: 3 ders saati</td></tr>
<tr><td>Konu – Alt konu:
Geometrik Cisimlerin Hacimleri
Dik Dairsel Koninin Hacmi</td><td>Kazanımlar:
3. Dik dairesel silindirin hacim bağıntısını oluşturur.
4. Geometrik cisimlerin hacimleri ile ilgili problemleri çözer ve kurar.</td><td colspan="2">Araç ve Gereç: kağıt, pergel, makas, cetvel, yapıştırıcı, kum

Ekler: (Ek#2)</td></tr>
<tr><td colspan="4">Ön koşullar:
Silindirde taban, yükseklik gibi kavramları şekil üzerinde gösterebilme
Silindirin hacim bağıntısını bilme
Silindirin hacim bağıntısını kullanabilme</td></tr>
<tr><td colspan="4">Öğretici Aktiviteler- 4. ders</td></tr>
<tr><td>Zaman</td><td colspan="3">Ders</td></tr>
<tr><td>15 dakika</td><td colspan="3">Koninin hacmini anlamak için gerekli olan önkoşul bilgiler şu şekilde pekiştirilir:
Öğrencilere verilmiş olan “Pretest- Volume” (TVpre) de uygulama konularıyla ilgili önkoşul bilgileri sorgulayan soruların olduğu ikinci kısımdan koni ile ilgili önkoşulu olan sorular sınıfta cevaplandırılır. Böylece öğrenciler koninin hacmini öğrenebilmek için gerekli olan silindirin hacim bağıntısı, hacim formülü, silindirin temel elemanları ve verilen değerlerle silindirin hacmini bulma ile ilgili önbilgilerini pekiştirmiş olurlar. Öğretmen her soru için istekli bir öğrenciyi tahtaya kaldırır ve ilgili sorular çözülür. Bu yolla tüm sınıfın eksik bilgilerini gidermeleri sağlanır.</td></tr>
<tr><td>10 dakika</td><td colspan="3">Aşağıdaki metin ve resim sunum şeklinde ekrana yansıtılır. Bu etkinlik okutularak öğrencilerden bir dondurma külahının boyutlarını tahmin etmeleri ve bu tahmin doğrultusunda külahın hacmini hesaplamaları beklenir. Bu etkinliğin cevabıyla ilgili sınıfta bir tartışma ortamı yaratılır.</td></tr>
</table>

<table>
<tr>
<td></td>
<td>Dondurma külahının hacmini hesaplayabilmek için dik dairesel silindirin hacim bağıntısına ihtiyaç olduğu hissettirilir. Bu bağıntıyı oluşturmak için de silindirin hacim bağıntısından nasıl yararlanılabileceği sorulur.

Tarihi çok eski zamanlara dayanan dondurma, insanların serinlemek, ferahlamak ve mutlu olmak için kar, çeşitli meyveler ve bal karışımından elde ettikleri bir yiyecekti. Günümüzde süt ve meyvelerden hazırlanan dondurmalar genellikle külahlarla servis edilir.
İçine konan dondurmanın eriyip ağzına kadar doldurduğu bir dondurma külahının hacmini hesaplaya bilirmisiniz?

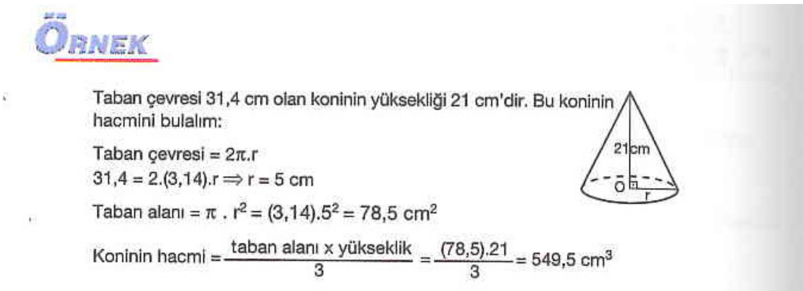
</td>
</tr>
<tr>
<td>15 dakika</td>
<td>Öğrencilere aşağıdaki “Doldur Boşalt” adlı etkinlik yaptırılır. Bu sayede öğrencilerin dik dairesel koninin hacim bağıntısını oluşturabilmeleri ve dik dairesel koninin hacmini strateji kullanarak tahmin edebilmeleri amaçlanmıştır. Öğrenciler sıra arkadaşlarıyla grup halinde çalışırlar.


ETKİNLİK
Araç ve Gereç
•Kâğıt
•Pergel
•Makas
•Cetvel
•Yapıştırıcı
•Kum

Doldur Boşalt
▶ Kâğıt, pergel, makas, cetvel ve yapıştırıcı kullanarak eş taban ve eş yükseklikte dik dairesel koni ve dik silindir modelleri oluşturalım.
▶ Silindir modelini kum ile tamamen dolduralım.
▶ Silindirdeki kumdan, koni modelini dolduracak kadar kum aktaralım.
▶ Bu işleme silindir boşalıncaya kadar devam edelim.
★ Silindirdeki kumla koniyi kaç kez doldurdunuz?
★ Eş taban ve eş yükseklikli koninin hacminin, dik silindirin hacmine olan oranını bulunuz. Nasıl bulduğunuzu açıklayınız.
★ Koninin hacim bağıntısını nasıl oluşturursunuz? Tartışınız.</td>
</tr>
<tr>
<td colspan="2">Ölçme: Öğretmen öğrenciler gerekli önkoşul bilgilerini cevaplarken sınıf içinde gezinir ve öğrencilerin cevaplarını kontrol eder. Anlamadıkları yerler ya da soruları olursa öğrencilere birebir yardımcı olur. Her soru tahtada cevaplandıktan sonra özet bir cümle kurarak cevabı pekiştirir.

Öğretmen derse hazırlık etkinliği sırasındaki sunum ve soruları ve koninin hacmiyle ilgili problemin cevabıyla ilgili tartışmayı yönlendirir, öğrencilerin katılımını sağlar.</td>
</tr>
</table>

<table>
<tr><td colspan="2">“Doldur Boşalt” etkinliğinde öğrencilerin sıra arkadaşlarıyla grup halinde çalışması takip edilir. Öğretmen etkinlik sırasında sınıf içerisinde gezinir ve ilgili soruları cevaplandırır.</td></tr>
<tr><td colspan="2" align="center">Öğretici Aktiviteler- 5. Ders</td></tr>
<tr><td align="center">Zaman</td><td align="center">Ders</td></tr>
<tr><td align="center">15 dakika</td><td>“Doldur Boşalt” etkinliğine devam edilir. Öğrencilerden silindirin hacminin koninin hacmine oranını tahmin etmeleri ve bu tahminlerini sınıfa açıklamaları istenir. Koninin hacim bağıntısıyla ilgili sınıfta tartışma ortamı oluşturulur ve gruplar fikirlerini paylaşırlar.</td></tr>
<tr><td align="center">10 dakika</td><td>Aşağıdaki örnek soru sınıfa inceletilir. Koninin hacminin bulunuşu bir örnek üzerinde görülür. Öğretmen sorunun adımlarını tahtadan anlatır.


ÖRNEK
Taban çevresi 31,4 cm olan koninin yüksekliği 21 cm'dir. Bu koninin hacmini bulalım:
Taban çevresi = $2\pi.r$
$31,4 = 2.(3,14).r \Rightarrow r = 5$ cm
Taban alanı = $\pi . r^2 = (3,14).5^2 = 78,5$ cm^2
Koninin hacmi = $\frac{\text{taban alanı x yükseklik}}{3} = \frac{(78,5).21}{3} = 549,5$ cm^3

Bu etkinlik ve örnekten sonra öğretmen öğrencilerin buldukları aşağıdaki bağıntıyı özet şeklinde tekrar eder.
Bir dik koninin hacmi, eş taban ve yüksekliğe sahip silindirin hacminin üçte biridir.

Koninin hacmi= (silindirin hacmi / 3) </td></tr>
<tr><td align="center">15 dakika</td><td>Problem Çözelim Kuralım etkinliği yaptırılır.</td></tr>
</table>

Problem Çözelim ve Kuralım

Yağmurlu ve karlı havalarda hava sıcaklığı 0°C'nin altına düştüğü zaman çatılarda koni şeklinde sarkıtlar oluşur. Yanda verilen resimdeki çatıda oluşan üç sarkıtın taban yarıçapları 6 cm, 7 cm, 9 cm; yükseklikleri ise 20 cm ve 21 cm ile 30 cm'dir. Buzun öz kütlesi (yoğunluğu) 0,918 g/cm^3 olduğuna göre üç sarkıtın ağırlığını bulunuz.

Öğrencilere bu problemi çözmeleri için nasıl bir plan takip edecekleri sorulur. Sınıfta bir tartışma ortamı yaratılır. Bu planlarını yazmaları ve ders sırasında uygulamaları istenir. Öğrenciler problemi çözdüğünde problemin aşağındaki cevabı tahtaya yansıtılır, bu cevap gönüllü bir öğrenci tarafından sınıfa açıklanır ve öğrencilerden cevaplarını kontrol etmeleri istenir.

Problemi Anlayalım

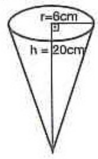
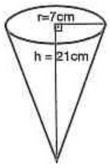
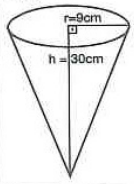
Problemde koni şeklindeki sarkıtların çapları ile yükseklikleri ve sarkıtı oluşturan buzun yoğunluğu ile ilgili ölçüler verilmiştir. Bu üç sarkıtın ağırlıklarını bulmamız isteniyor.

Plan Yapalım

Önce koni şeklindeki sarkıtların hacimlerini hesaplarız. Hesapladığımız cm^3 cinsinden hacimler ile buzun öz kütlesini çarparak sarkıtların ağırlığını buluruz.

Planı Uygulayalım

Koni şeklindeki sarkıtların şekilleri, hacimleri ve kütleleri aşağıdadır.

Şekil			
Hacim $\frac{\pi . r^2 . h}{3}$	$\frac{(3,14).6^2 . 20}{3}$ = 753,6 cm^3	$\frac{(3,14).7^2 . 21}{3}$ = 1077,02 cm^3	$\frac{(3,14).9^2 . 30}{3}$ = 2543,4 cm^3
Kütle Hacim x yoğunluk	Kütle (753,6) x (0,918) = 691,804 g ≈ 692 g	(1077,02) x (0,918) = 988,70436 g ≈ 989 g	2543,4 x (0,918) = 2334,8412 g ≈ 2335 g

Kontrol Edelim

Yapılan işlemlerin doğruluğunu strateji kullanarak kontrol ediniz.

Ölçme : Öğretmen sınıf içi tartışmayı yönlendirir ve öğrencilerin katılımını sağlar.

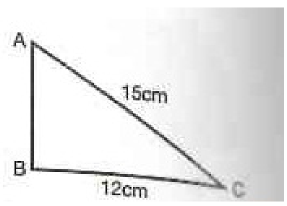
Öğretmen öğrenciler problem üzerinde çalışırken sınıf içinde gezinir ve öğrencilerle ilgilenir. Anlamadıkları yerler ya da soruları olursa öğrencilere birebir yardımcı olur.

Öğretici Aktiviteler- 6. ders

Zaman	Ders
15 dakika	Öğrencilerden dik dairesel koninin hacmi ile ilgili Figure çizilerek çözülebilecek bir problem kurmaları ve çözmeleri beklenir. Bu soruyla öğrencilerin kendilerinin bir problem oluşturması ve daha sonra bunu çözmeleri amaçlanmıştır. Soruyu çözdükten sonra her öğrenci soru ve cevabını yanındaki sıra arkadaşıyla değiştirir ve arkadaşının problemini kontrol eder. Cevabın yanlış olduğunu düşündüklerinde arkadaşıyla birlikte sorunun cevabı üzerinde tekrar düşünürler ve anlamadıkları yer olursa öğretmene sorarlar.
25 dakika	Bu kısımdan sonra uygulama sorularına geçilmektedir. Uygulama soruları öğrencilerin bu konuyla ilgili öğrendikleri problemlerden oluşmuştur. Uygulama soruları ders saatinde çözülmeye başlanır (Ek#2) Ders süresinde yetişmeyen sorular eve ödev verilir. Daha sonra doğruluğu kontrol edilir.
Ölçme : Öğretmen öğrenciler problem üzerinde çalışırken sınıf içinde gezinir ve öğrencilerle ilgilenir. Anlamadıkları yerler ya da soruları olursa öğrencilere birebir yardımcı olur. **Öğretmenin uygulama soruları sırasında öğrencilerin aralarında gezmesi ve onlara yardımcı olması, kimlerin ne kadar anladıklarını ölçmesi açısından önemlidir. Her öğrenci çözme hızı ve seviyesine göre soruları çözer. Kalan soruların ev ödevi olarak çözülmesi istenir. Böylece, daha yavaş çözebilen ya da daha yavaş anlayan öğrenciler evde vakit ayırarak diğer arkadaşlarına yetişebilirler.**	

Ek#2: Koninin Hacmi ile İlgili Uygulama (MEB, 2009)

1. Aşağıdaki ABC dik üçgeni AB dik kenarı etrafında 180° döndürüldüğünde oluşan cismin hacmi kaç santimetreküptür?



2. Bir dik koninin taban alanı 25 cm^2 ve hacmi 100 cm^3 olduğuna göre yüksekliği kaç santimetrekaredir?

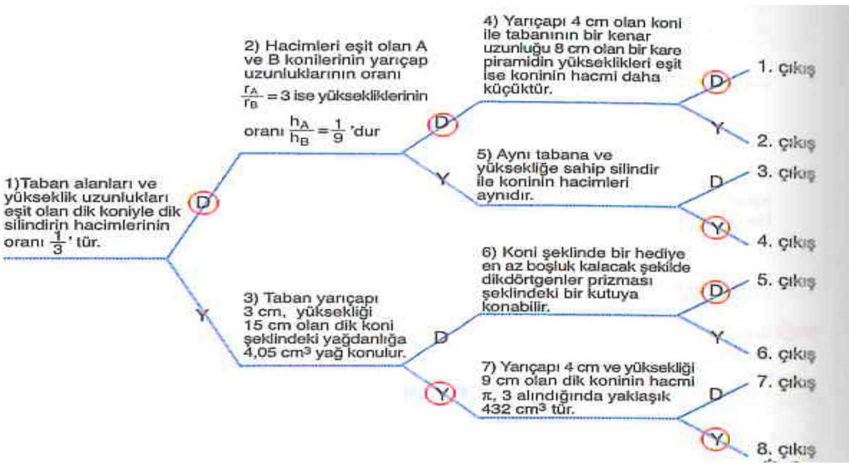
3. Bir dik silindirin içine taban çapı ve yüksekliğinin uzunluğu silindirin taban çapının ve yüksekliğinin uzunluğunun yarısı olan bir dik koni yerleştiriliyor. Koninin hacminin silindirin hacmine olan oranını bulunuz.

4. Yüksekliği 10 cm, taban yarıçapı 5 cm. olan dik koni şeklindeki bir kaba, bir kenarının uzunluğu 5 cm. olan küp şeklindeki kapla kaç kez su boşaltılırsa koni şeklindeki kap dolmuş olur? (∏=3 alınız) ?

5. Aşağıda yarıçapı ve yükseklik uzunlukları verilen dik konilerin hacimlerinin oranı hakkında ne söyleyebilirsiniz?
   a. r= 3 cm. b) r= 5 cm
      h= 5 cm. h= 3 cm

6. Yandaki verileri kullanarak bir problem kurunuz ve çözünüz. r= 2,5 cm
h = 3,5 cm

6. Aşağıda birbiriyle bağlantılı doğru / yanlış cümleler verilmiştir. Şemadaki cümlelerde doğru olduğu belirtilen yargı yanlış, yanlış olduğu belirtilen yargı doğru olabilir. Her bir doğru / yanlış kararı sizi farklı çıkışlara ulaştırır ve alacağınız puanı etkiler. Buna göre aşağıdaki çıkışlardan birine ulaşınız.



Öğretmen: Özlem ALBAYRAK	**Sınıf seviyesi: 8** **Ders: Matematik**	**Ünite 5: Geometrik Cisimlerde Ölçme ve Perspektif**	**Tarih: May 2010** **Süre: 2 ders saati**
Konu – Alt konu: • **Geometrik Cisimlerin Hacimleri** ○ **Kürenin Hacmi**	**Kazanımlar:** **5. Kürenin hacim bağıntısını oluşturur.** **6. Geometrik cisimlerin hacimleri ile ilgili problemleri çözer ve kurar.**		**Araç ve Gereç:** **kağıt, pinpon topu, makas, yapıştırıcı, kum** **Ekler: (Ek#3)**

Ön koşullar:

- **Silindirde taban, yükseklik gibi kavramları Figure üzerinde gösterebilme**
- **Silindirin hacim bağıntısını bilme**
- **Silindirin hacim bağıntısını kullanabilme**

Öğretici Aktiviteler- 7. Ders

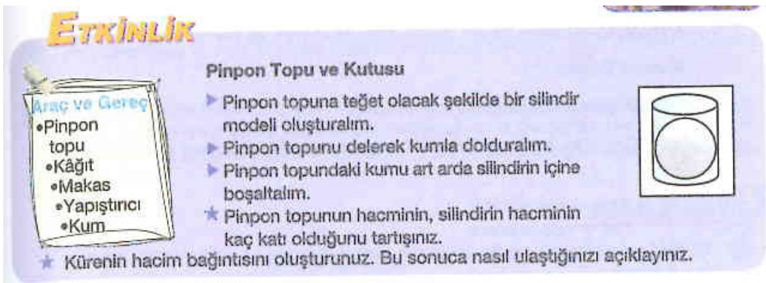
Zaman	Ders
5 dakika	Kürenin hacmini anlamak için gerekli olan önkoşul bilgiler koninin hacmini bulmak için gerekli önkoşul bilgilerle aynıdır. Bu önkoşul bilgiler silindirin hacim bağıntısı, hacim formülü, silindirin temel elemanları ve verilen değerlerle silindirin hacmini bulma ile ilgili bilgilerdir. Koninin hacmi öğrenilmeden önce bu bilgiler tekrar edilmiştir. Bu yüzden öğretmen kısaca bu bilgileri özetler.
10 dakika	Aşağıdaki metin ve resim sunum şeklinde ekrana yansıtılır. Bu etkinlik okutularak öğrencilere bir cismin özkütlesini bulmak için o cismin ağırlığının hacmine bölünmesi gerektiği açıklanır. Öğrencilere bu işlem için bir kürenin hacminin hesaplanması gerektiği hissettirilir. Bu etkinliğin cevabıyla ilgili sınıfta bir tartışma ortamı yaratılır.

<table>
<tr><td></td><td>


Kürenin Hacmi

Üzüm, sağlık ve şifa kaynağıdır. İçerisindeki bir çok vitamin ve mineral, bağışıklık sistemimizin güçlenmesinde etkili rol oynamaktadır. Çapı yaklaşık 1 cm olan bir üzüm tanesi yaklaşık 7g gelmektedir. Bu üzüm tanesinin öz kütlesini hesaplayabilir misiniz?
</td></tr>
<tr><td>20 dakika

5 dakika</td><td>
Öğrencilere aşağıdaki “Pinpon Topu ve Kutusu” adlı etkinlik yaptırılır. Bu sayede öğrencilerin kürenin hacim bağıntısını oluşturabilmeleri ve kürenin hacmini strateji kullanarak tahmin edebilmeleri amaçlanmıştır. Öğrenciler sıra arkadaşlarıyla grup halinde çalışırlar.



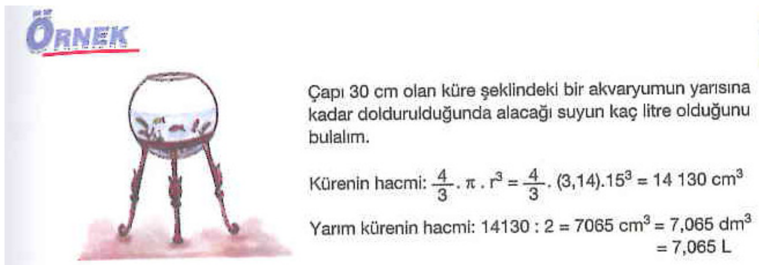
ETKİNLİK

Araç ve Gereç: •Pinpon topu •Kâğıt •Makas •Yapıştırıcı •Kum

Pinpon Topu ve Kutusu

- Pinpon topuna teğet olacak şekilde bir silindir modeli oluşturalım.
- Pinpon topunu delerek kumla dolduralım.
- Pinpon topundaki kumu art arda silindirin içine boşaltalım.
- ★ Pinpon topunun hacminin, silindirin hacminin kaç katı olduğunu tartışınız.
- ★ Kürenin hacim bağıntısını oluşturunuz. Bu sonuca nasıl ulaştığınızı açıklayınız.

Aşağıdaki örnek soru sınıfa inceletilir. Kürenin hacminin bulunuşu bir örnek üzerinde görülür. Öğretmen sorunun adımlarını tahtadan anlatır.



ÖRNEK

Çapı 30 cm olan küre şeklindeki bir akvaryumun yarısına kadar doldurulduğunda alacağı suyun kaç litre olduğunu bulalım.

Kürenin hacmi: $\frac{4}{3}.\pi.r^3 = \frac{4}{3}.(3,14).15^3 = 14\,130\ cm^3$

Yarım kürenin hacmi: $14130 : 2 = 7065\ cm^3 = 7,065\ dm^3 = 7,065\ L$

Bu etkinlik ve örnekten sonra öğretmen öğrencilerin buldukları aşağıdaki bağıntıyı özet şeklinde tekrar eder.

Bir koninin hacmi, eş taban ve yüksekliğe sahip silindirin üçte biridir.
Koninin hacmi = Silindirin hacmi / 3
</td></tr>
</table>

Ölçme*:* Öğretmen öğrenciler gerekli önkoşul bilgilerini cevaplarken sınıf içinde gezinir ve öğrencilerin cevaplarını kontrol eder. Anlamadıkları yerler ya da soruları olursa öğrencilere birebir yardımcı olur. Her soru tahtada cevaplandıktan sonra özet bir cümle kurarak cevabı pekiştirir.

Öğretmen derse hazırlık etkinliği sırasındaki sunum ve soruları ve kürenin hacmiyle ilgili problemin cevabıyla ilgili tartışmayı yönlendirir, öğrencilerin katılımını sağlar.

"Pinpon Topu ve Kutusu" etkinliğinde öğrencilerin sıra arkadaşlarıyla grup halinde çalışması takip edilir. Öğretmen etkinlik sırasında sınıf içerisinde gezinir ve ilgili soruları cevaplandırır.

Öğretici Aktiviteler- 8. Ders

Zaman	Ders
15 dakika	Kürenin hacim formülünü öğrendikten sonra problem çözelim ve kuralım etkinliği yaptırılır: Problem Çözelim ve Kuralım  Camdan yapılmış bir küre hediye olarak alınıyor. Bir kenarının uzunluğu 30 cm olan küp şeklindeki kutuya konuluyor. Kutuda boş kalan kısımlara ise kürenin zarar görmemesi için ambalaj köpükleri dolduruluyor. Kürenin yarıçapı 12 cm olduğuna göre ambalaj köpüklerinin hacmini bulunuz. Öğrencilere bu problemi çözmeleri için nasıl bir plan takip edecekleri sorulur. Sınıfta bir tartışma ortamı yaratılır. Bu planlarını yazmaları ve ders sırasında uygulamaları istenir. Öğrenciler problemi çözdüğünde problemin aşağındaki cevabı tahtaya yansıtılır, bu cevap gönüllü bir öğrenci tarafından sınıfa açıklanır ve öğrencilerden cevaplarını kontrol etmeleri istenir.

<table>
<tr><td></td><td>Problemi Anlayalım
Yarıçapı 12 cm olan küre şeklindeki hediye, bir kenarının uzunluğu 30 cm olan küp şeklindeki kutuya konmuş. Camdan yapılmış kürenin zarar görmemesi için boşluklar ambalaj köpükleriyle doldurulmuş. Ambalaj köpüklerinin hacmi soruluyor.
Plan Yapalım
Ambalaj köpüklerinin hacmini bulmak için küp şeklindeki kutunun hacminden kürenin hacmini çıkarmamız yeterlidir.
Planı Uygulayalım
Kürenin hacmi: $\frac{4}{3}\pi r^3 = \frac{4}{3} . (3,14) . (12)^3 = 7234,56\ cm^3$
Küpün hacmi: $(30)^3 = 27\,000\ cm^3$
Ambalaj köpüklerinin hacmi: $27000-7234,56=19765,44\ cm^3$
Kontrol Edelim
Yapılan işlemin doğruluğunu kontrol ediniz.</td></tr>
<tr><td>10 dakika</td><td>Öğrencilerden kubbe, 20 m, alan, hacim verilerini kullanarak küre ile ilgili bir problem kurmaları ve çözmeleri beklenir. Bu soruyla öğrencilerin kendilerinin bir problem oluşturması ve daha sonra bunu çözmeleri amaçlanmıştır. Soruyu çözdükten sonra her öğrenci soru ve cevabını yanındaki sıra arkadaşıyla değiştirir ve arkadaşının problemini kontrol eder. Cevabın yanlış olduğunu düşündüklerinde arkadaşıyla birlikte sorunun cevabı üzerinde tekrar düşünürler ve anlamadıkları yer olursa öğretmene sorarlar.</td></tr>
<tr><td>15 dakika</td><td>Bu kısımdan sonra uygulama sorularına geçilmektedir. Uygulama soruları öğrencilerin bu konuyla ilgili öğrendikleri problemlerden oluşmuştur. Uygulama soruları ders saatinde çözülmeye başlanır (Ek#2) Ders süresinde yetişmeyen sorular eve ödev verilir. Daha sonra doğruluğu kontrol edilir.</td></tr>
<tr><td colspan="2">Ölçme : Öğretmen sınıf içi tartışmayı yönlendirir ve öğrencilerin katılımını sağlar.

Öğretmen öğrenciler problem üzerinde çalışırken sınıf içinde gezinir ve öğrencilerle ilgilenir. Anlamadıkları yerler ya da soruları olursa öğrencilere birebir yardımcı olur.

Öğretmenin uygulama soruları sırasında öğrencilerin aralarında gezmesi ve onlara yardımcı olması, kimlerin ne kadar anladıklarını ölçmesi açısından önemlidir. Her öğrenci çözme hızı ve seviyesine göre soruları çözer. Kalan soruların ev ödevi olarak çözülmesi istenir. Böylece, daha yavaş çözebilen ya da daha yavaş anlayan öğrenciler evde vakit ayırarak diğer arkadaşlarına yetişebilirler.</td></tr>
</table>

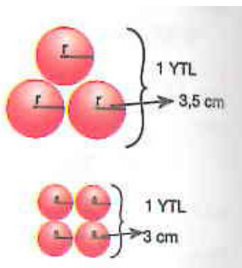
Ek#3: Kürenin Hacmi ile İlgili Uygulama (MEB, 2009)

1. Büyük çemberinin çevresi 66 m. olan bir kürenin hacmini ve yüze alanını bulunuz.

2. Aşağıdaki yarıçapı 5 cm, yüksekliği 34 cm olam dik silindir şeklindeki fanusa, büyük dairesinin yarıçapı 4 cm olan dört adet küre şeklinde mavi bilye yerleştiriliyor. Fanus içinde kalan boşluğa ise beyaz renkli boncuklardan doldurularak masa süsü oluşturulmak isteniyor. Beyaz boncuklar kaç santimetreküp yere yerleşecektir? (∏=3)

3. r_1= 4 cm, r_2 = 8cm, misket, terazi verilerini kullanarak uygun bir problem kurarak çözümünü yapınız.

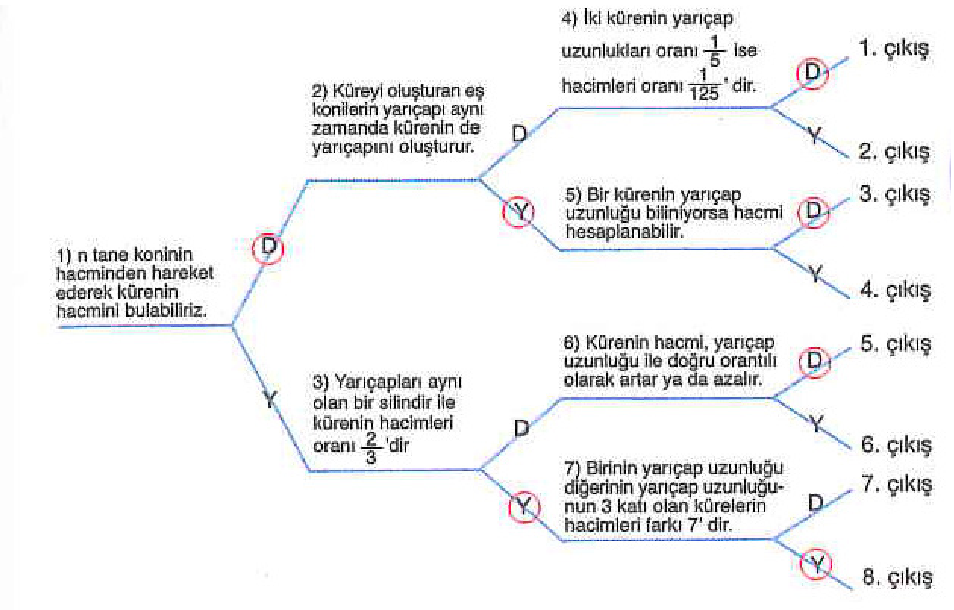
4. Aşağıda aynı kalitede küre şeklindeki elmaların boyutları ve her gruba ödenecek tutar yazılmıştır. Karlı bir alışveriş yapmak açısından hangi elma grubunu tercih edersiniz? Neden?



5. Aşağıdaki resimde küre şeklindeki bir kavunun yarısına ait kesit verilmiştir. Kavunun kabuklu iken yarıçapı 11 cm, kabuğu soyulduğunda ise yarıçapı 10 cm'dir. Yarın kavun Figurede gösterildiği gibi tepesinden 20° lik açılarla dilimlere ayrılacaktır. Buna göre (∏=3):
   a) Yarım kavun kaç dilime ayrılmış olur?
   b) Yarım kavunun hacmini bulunuz.
   c) Kabuksuz servis edilen bir kavun diliminin hacmini hesaplayınız.
   d) Bu kavun tüm olsaydı kabukları kaç cm^3 olurdu?

6. Yarıçapları oranı 3/5 olan iki kürenin hacimlerinin oranı bulunuz.
7. Aşağıda birbiriyle bağlantılı doğru / yanlış cümleler verilmiştir. Şemadaki cümlelerde doğru olduğu belirtilen yargı yanlış, yanlış olduğu belirtilen yargı doğru olabilir. Her

bir doğru / yanlış kararı sizi farklı çıkışlara ulaştırır ve alacağınız puanı etkiler. Buna göre aşağıdaki çıkışlardan birine ulaşınız.



APPENDIX H: INSTRUCTION INTEGRATED WITH HISTORY OF MATHEMATICS –LESSON PLAN

Öğretmen: **Özlem ALBAYRAK**	**Sınıf seviyesi: 8** **Ders: Matematik**	**Ünite 5: Geometrik Cisimlerde Ölçme ve Perspektif**	**Tarih: May 2010** **Süre: 3 ders saati**

Konu – Alt konu: • **Geometrik Cisimlerin Hacimleri** o **Dik Piramidin Hacmi**	**Kazanımlar:** **7. Dik piramidin hacim bağıntısını oluşturur.** **8. Geometrik cisimlerin hacimleri ile ilgili problemleri çözer ve kurar.**	**Araç ve Gereç: kağıt, cetvel, makas, bant, kum** **Ekler: (Ek#1), (Ek#2), (Ek#3), (Ek#4), (Ek#5),**

Ön koşullar: • **Prizmalarda taban, yükseklik gibi kavramları Figure üzerinde gösterebilme** • **Prizmaların tabanlarına göre isimlendirildiklerini bilme** • **Prizmaların hacim bağıntılarını bilme** • **Prizmaların hacim bağıntılarını kullanabilme**
Öğretici Aktiviteler- 1. ders

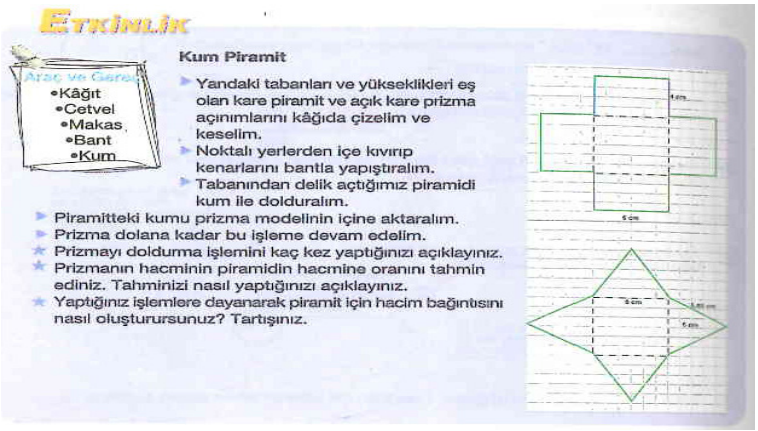
Zaman	Ders
15 dakika	Piramitlerin hacmini anlamak için gerekli olan önkoşul bilgiler şu şekilde pekiştirilir: Öğrencilere verilmiş olan "Pretest- Volume" (TVpre) de uygulama konularıyla ilgili önkoşul bilgileri sorgulayan soruların olduğu ikinci kısımdan piramitlerle ilgili önkoşulu olan sorular sınıfta cevaplandırılır. Böylece öğrenciler piramitlerin hacmini öğrenebilmek için gerekli olan prizmaların hacim bağıntısı, hacim formülü, prizmaların temel elemanları ve verilen değerlerle prizmaların hacmini bulma ile ilgili önbilgilerini pekiştirmiş olurlar.

10 dakika	Öğretmen her soru için istekli bir öğrenciyi tahtaya kaldırır ve ilgili sorular çözülür. Bu yolla tüm sınıfın eksik bilgilerini gidermeleri sağlanır. Aşağıdaki metin ve resim sunum şeklinde ekrana yansıtılır. Ekrandaki metin okutularak sorunun cevabıyla ilgili sınıfta bir tartışma ortamı oluşturulur. Bu yapının hacmini hesaplayabilmek için dik piramidin hacim bağıntısına ihtiyaç olduğu hissettirilir. Bu bağıntıyı oluşturmak için de prizmaların hacim bağıntısından nasıl yararlanılabileceği sorulur. Mısırda en çok bilinen piramitler Gize bölgesinde bulunmaktadır. Aşağıda görülen resim bu piramitlerden birine aittir. Taban alanı 4500 m^2, yerden yüksekliği 22,76 metredir olan bu yapının hacmi yaklaşık olarak kaç metreküptür? 

15 dakika	Matematik tarihi dahil edilerek giriş etkinliği olarak öğrencilere aşağıdaki sorular sorulur: Çevremizde piramitleri birçok yerde görebiliriz. Bunlara örnekler nelerdir? Yapı olarak bilinen en meşhur piramitler nerededir? (Mısır) Mısırlıların bundan binlerce yıl önce bugün hala kullandığımız birçok temel matematik ve geometri bilgisini bildiklerinden bahsedilir. (Bu konudaki sunum gösterilir. İlgi çekmek için sunumda Mısır piramitleriyle ilgili genel bilgi verilir.) (Ek#1) Sunumdan sonra aşağıdaki soru sorulur: Sizce, Mısırlılar, ilkel geometri bilgisi diyebileceğimiz, ama bugünkü geometrinin temel bilgilerini, hangi ihtiyaçları sonucu ortaya koymuşlardır? Yani geometriye neden ihtiyaç duyulabilir? (İpucu verilmesi gerekir!) • Burada geometrinin hangi alanlarda etkili olduğunu düşünebiliriz. • Geometri tarihte neden önemli olabilir? • Geometri tarihte nerelerde, hangi işlerde kullanılabilir. (sunumla paralel tartışma yöntemi- derse ilgi çekme) Bu soruların cevaplarıyla paralel olarak geometri ve ilgili konu olan hacim kavramının ortaya çıkışıyla ilgili sunum gösterilir. (Ek#2) İşleyeceğimiz konu olan piramidin hacmi ve koninin hacmi ile ilgili bilgileri ilk kez Öklit'in verdiğinden bahsedilir ve Öklit'in hayatıyla ve çalışmalarıyla ilgili bir sunum izlettirilir. (Ek#3) Öklit'in "Elementler" adlı kitabı, piramit ve koninin hacminin bulunması ile ilgili bilgiler içerdiğinden bahsedilir. O günlerde prizmanın ve silindirin hacmi bilindiği, Öklit'in, bu bilgileri kullanarak prizma ve koninin hacminin bulunması ile ilgili bilgiler verdiği anlatılır.
Ölçme *:* **Öğretmen öğrenciler gerekli önkoşul bilgilerini cevaplarken sınıf içinde gezinir ve öğrencilerin cevaplarını kontrol eder. Anlamadıkları yerler ya da soruları olursa öğrencilere birebir yardımcı olur. Her soru tahtada cevaplandıktan sonra özet bir cümle kurarak cevabı pekiştirir.**	

<table>
<tr><td colspan="2">Öğretmen derse hazırlık etkinliği sırasındaki sunum ve sorular ile ilgili tartışmayı yönlendirir. Konuyla ilgili matematik tarihi bilgileri vererek öğrencilerin derse olan motivasyonlarını arttırır.</td></tr>
<tr><td colspan="2" align="center">Öğretici Aktiviteler- 2. Ders</td></tr>
<tr><td align="center">Zaman</td><td align="center">Ders</td></tr>
<tr><td align="center">30 dakika</td><td>Öğrencilerin derse karşı ilgi ve motivasyonlarını arttırıcı bilgiler verdikten sonra aşağıdaki “Kum Piramit” etkinliği yaptırılır. Bu sayede öğrencilerin kendilerini tarihteki bir matematikçinin yerine koyup dik piramidin hacim bağıntısını oluşturabilmeleri ve dik piramidin hacmini strateji kullanarak tahmin edebilmeleri amaçlanmıştır. Öğrenciler sıra arkadaşlarıyla grup halinde çalışırlar.

Etkinlikten önce aşağındaki öğretmen tarafından aşağıdaki yönlendirme verilir:
Şimdi kendimizi Öklit’in yerine koyalım ve “Kum Piramit “ etkinliğini yapalım. Bakalım Öklit’ in “Elementler” adlı kitabında piramidin hacmi ile ilgili bulduğu sonuca ulaşabilecek miyiz?


ETKİNLİK
Kum Piramit
•Kâğıt
•Cetvel
•Makas
•Bant
•Kum
▶ Yandaki tabanları ve yükseklikleri eş olan kare piramit ve açık kare prizma açınımlarını kâğıda çizelim ve keselim.
▶ Noktalı yerlerden içe kıvırıp kenarlarını bantla yapıştıralım.
▶ Tabanından delik açtığımız piramidi kum ile dolduralım.
▶ Piramitteki kumu prizma modelinin içine aktaralım.
▶ Prizma dolana kadar bu işleme devam edelim.
★ Prizmayı doldurma işlemini kaç kez yaptığınızı açıklayınız.
★ Prizmanın hacminin piramidin hacmine oranını tahmin ediniz. Tahminizi nasıl yaptığınızı açıklayınız.
★ Yaptığınız işlemlere dayanarak piramit için hacim bağıntısını nasıl oluşturursunuz? Tartışınız.

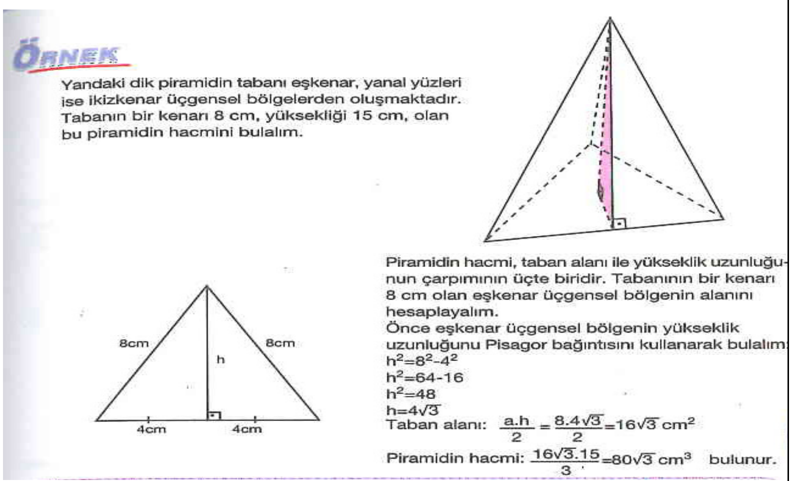
Bu etkinlikten sonra öğrencilerden prizmanın hacmini piramidin hacmine oranını tahmin etmeleri ve bu tahminlerini sınıfa açıklamaları istenir. Piramidin hacim bağıntısıyla ilgili sınıfta tartışma ortamı oluşturulur ve gruplar fikirlerini paylaşırlar.

Öğretmen öğrencilerin cevaplarını aldıktan sonra Öklit’in kitabındaki sonucu sınıfla paylaşır:</td></tr>
</table>

<table>
<tr>
<td></td>
<td>Dik piramidin hacmi, kendisine eş tabana ve yüksekliğe ait dikdörtgenler prizmasının üçte biridir.

Öklit bu konuyla ilgili formül oluşturmamıştır, yalnızca yukarıdaki bağıntıdan bahsetmiştir. Prizmanın hacim bağıntısını kullanarak bir formül oluşturacak olursak aşağıdaki gibi olur:

Dik piramidin hacmi: (taban alanı X yükseklik) / 3</td>
</tr>
<tr>
<td>10 dakika</td>
<td>Aşağıdaki örnek soru sınıfa inceletilir. Piramidin hacminin bulunuşu bir örnek üzerinde görülür. Öğretmen sorunun adımlarını tahtadan anlatır.



ÖRNEK
Yandaki dik piramidin tabanı eşkenar, yanal yüzleri ise ikizkenar üçgensel bölgelerden oluşmaktadır. Tabanın bir kenarı 8 cm, yüksekliği 15 cm, olan bu piramidin hacmini bulalım.
8cm
8cm
h
4cm
4cm
Piramidin hacmi, taban alanı ile yükseklik uzunluğunun çarpımının üçte biridir. Tabanının bir kenarı 8 cm olan eşkenar üçgensel bölgenin alanını hesaplayalım.
Önce eşkenar üçgensel bölgenin yükseklik uzunluğunu Pisagor bağıntısını kullanarak bulalım:
$h^2=8^2-4^2$
$h^2=64-16$
$h^2=48$
$h=4\sqrt{3}$
Taban alanı: $\frac{a.h}{2}=\frac{8.4\sqrt{3}}{2}=16\sqrt{3}\ cm^2$
Piramidin hacmi: $\frac{16\sqrt{3}.15}{3}=80\sqrt{3}\ cm^3$ bulunur.</td>
</tr>
<tr>
<td colspan="2">Ölçme : Kum piramit etkinliğinde öğrencilerin sıra arkadaşlarıyla grup halinde çalışması takip edilir. Öğretmen etkinlik sırasında sınıf içerisinde gezinir ve ilgili soruları cevaplandırır.

Öğretmen sınıf içi tartışmayı yönlendirir ve öğrencilerin katılımını sağlar.</td>
</tr>
<tr>
<td colspan="2">Öğretici Aktiviteler- 3. ders</td>
</tr>
<tr>
<td>Zaman</td>
<td>Ders</td>
</tr>
</table>

15 dakika	Bu etkinlikten sonra papirüs şeklindeki çalışma kağıdı öğrencilere verilir. Tarihi bir belge olan Moscow papirüsünde yer alan problemi, problem çözelim ve kuralım etkinliği olarak yapmaları beklenir. (Ek#4) Öğrencilere bu problemi çözmeleri için nasıl bir plan takip edecekleri sorulur. Sınıfta bir tartışma ortamı yaratılır. Bu planlarını yazmaları ve ders sırasında uygulamaları istenir. Öğrenciler problemi çözdüğünde problemin cevabı tahtaya yansıtılır, bu cevap gönüllü bir öğrenci tarafından sınıfa açıklanır ve öğrencilerden cevaplarını kontrol etmeleri istenir.
15 dakika	Öğrencilerden dik piramidin hacmini ile ilgili tarihle ilişkilendirerek ve şekil çizerek bir problem kurmaları ve çözmeleri beklenir.Bu soruyla öğrencilerin kendilerinin bir problem oluşturması ve daha sonra bunu çözmeleri ve bu sırada da tarihle ilişkilendirerek problemi kendileri için daha eğlenceli hale getirmeleri amaçlanmıştır. Soruyu çözdükten sonra her öğrenci soru ve cevabını yanındaki sıra arkadaşıyla değiştirir ve arkadaşının problemini kontrol eder. Cevabın yanlış olduğunu düşündüklerinde arkadaşıyla birlikte sorunun cevabı üzerinde tekrar düşünürler ve anlamadıkları yer olursa öğretmene sorarlar.
10 dakika	Bu kısımdan sonra uygulama sorularına geçilmektedir. Uygulama soruları öğrencilerin bu konuyla ilgili öğrendikleri problemlerden oluşmuştur. Uygulama soruları ders saatinde çözülmeye başlanır (Ek#5) Kalan soruların çözümüne bir sonraki ders saatinde devam edileceği söylenir.
Ölçme : Öğretmen öğrenciler problem üzerinde çalışırken sınıf içinde gezinir ve öğrencilerle ilgilenir. Anlamadıkları yerler ya da soruları olursa öğrencilere birebir yardımcı olur. **Öğretmenin uygulama soruları sırasında öğrencilerin aralarında gezmesi ve onlara yardımcı olması, kimlerin ne kadar anladıklarını ölçmesi açısından önemlidir. Her öğrenci çözme hızı ve seviyesine göre soruları çözer.**	

Ek#1: Mısır piramitleri Sunumu (Mısır Piramitleri, 2011)

- Mısır Piramitleri, Mısır'da yer alan eski piramit şekillerde yapılardır.
- Mısır'da 100'den fazla piramit vardır.
- Piramitlerin çoğu Eski Krallık Dönemi'nden Orta Krallık Dönemi'ne kadar firavunların mezarı için inşa edilmiştir.
- Bilinen en eski piramit 3. Hanedan döneminde inşa edilen Basamaklı Piramit'tir.
- Ayrıca bu yapılar dünyanın en eski şekilli taşlardan inşa edilmiş yapısıdır.
- En çok bilinen piramitler Gize'de bulunmuştur.
- Birkaç Gize Piramidi inşa edilmiş en büyük yapılardandır.
- Gize Piramitleri'nin en büyüğü olan Keops Piramidi şu ana kadar zarar görmeden ayakta duran, Dünya'nın Yedi Harikası'ndan biri olarak görülmektedir.

Ek# 2: **Geometri ve Hacim Kavramının Tarihiyle İlgili Sunum (Dönmez, 1986)**

- Geometrinin "yer ölçme" (geo: yer, metr: ölçüm) anlamı aslında tarihin derinliklerinde geometrinin taşıdığı anlamdır.
- İnsanoğlu toprak ile karşılaştığında ondan yararlanmaya, ona sahip olmaya başlamıştır.
- Bu durumda matematiğin M.Ö. 3000 -2000 yılları arasında Mısır ve Mezopotamya'da başladığını söyleyebiliriz.
- Heredot'a (M.Ö. 485-415) göre, matematik Mısır'da başlamıştır.
- Mısır topraklarının yüzde 97 si tarıma elverişli değildir; Mısır'a hayat veren, Nil deltasını oluşturan yüzde üçlük kısımdır.
- Bu nedenle, bu topraklar son derece değerlidir.
- Oysa, her sene yaşanan Nil nehrinin neden olduğu taşkınlar sonuncunda, toprak sahiplerinin arazilerinin hudutları belirsizleşmektedir.
- Toprak sahipleri de sahip oldukları toprakla orantılı olarak vergi ödedikleri için, her taşkından sonra, devletin bu işlerle görevli "geometricileri" gelip, gerekli ölçümleri yapıp, toprak sahiplerine bir önceki yılda sahip oldukları toprak kadar toprak vermeleri gerekmektedir.
- Heredot geometrinin bu ölçüm ve hesapların sonucu olarak oluşmaya başladığını söylemektedir. Bu gayretler devam ettikçe geometri gelişmiştir.
- Hacim kavramı pratik kullanıma olanak sağlamasından ötürü yüzyıllar boyunca önemli bir konu olmuştur. Mısırlılar bu konuda öncüdürler.
- Piramitlerin inşası onların geometrik fonksiyonlarla olan tanışıklıklarına bir kanıttır. Bunun dışında Moscow papirüsünde 25 pratik soru vardır. Bunlardan 14 numaralı olan kesik piramidin hacminin bulunmasıyla ilgili formüldür.
- Mısırlılar geometri konusunda öncü olmalarına rağmen ve hacim kavramına aşına olmalarına rağmen Mısır geometrisinde genel bir formül anlayışı yoktur. Geometri problemlerinin çözümü yalnızca özel hallerin ele alınmasından ibarettir.

- Eski Yunanlılar, Eski Mısır yörelerini uzun yıllar dolaşmışlar. Bu yöreleri ilk dolaşan ve Eski Yunan'ın ilk bilgini (bilgesi) sayılan Thalestir (M.Ö. 640 -548).
- Thales'ten sonra Pisagor'un ve Öklid'in bu yöreleri uzun yıllar dolaştıkları tarihi bir gerçektir.
- Bu bilginler, buralardan elde ettikleri geometri bilgilerini almışlardır ve geometriyi sistemli ispatlara dayanan müstakil bir bilim haline getirmişlerdir.
- Eski Yunanlılar'ın başarısı, geometriyi sistemleştirip, özel bir matematik dalı haline getirmiş olmalarıdır.
- Yunanlı bir bilgin olan Euclid, geometriye yaptığı çalışmalarından ötürü geometrinin babası olarak bilinir.

Ek# 3: **Öklit'in Hayatı ve Çalışmaları ile İlgili Sunum (Struik, 2002)**

- Öklit (M.Ö. 365-300)
- Mısır'ın İskenderiye şehrinde doğdu.
- "Temel Öğeler ya da Elementler" adlı yapıtıyla, son zamanlara dek geçerliliğini koruyan matematiğin temellerini atmıştı. Bu geometri halen lise öğrencilerine okutulmaktadır.
- Öklit, kendinden önce gelenlerin eserleriyle kendi öz yapıtlarını da derleyerek, bugün Öklit geometrisi adıyla bilinen geometriyi, aksiyomlarına dayandırarak geliştirmiştir.
- İskenderiye'de önemli bir matematik okulu açmış ve burada matematik dersleri okutmuştur.
- Kendisinden önce ispat edilen teoremleri toplayarak bir derleme kitabı yazmıştır.
- Zamanın kralı olan I. Batlamyus, Öklit'in bu okulunu ziyaret etmiştir. Herhalde Öklit'in anlattığı matematik derslerini anlayamamış veya anlaşılması ona zor gelmiş. Öklit'e matematiğin öğretimini ve öğrenimini kolaylaştıracak yöntemler bulunmasını emretmek istemiş. Herkese boyun eğmeyen bu gerçek alim, tarihe geçen sözüyle, "İlim için kral yolu yoktur." diyerek karşılık vermiştir.
- Geometriyi ispat ve aksiyomlara dayalı bir dizge olarak işleyen 13 ciltlik kitabı "Elementler" bu alandaki ilk kapsamlı çalışmaydı.
- Kendinden önceki Tales, Pisagor, Platon, Aristoteles gibi matematikçi ve geometricilerin çalışmalarını temel alan Öklid'in bu yapıtı, iki bin yıl boyunca önemli bir başvuru kaynağı olarak kullanılmıştır.
- Öklid'in her önermeyi daha önceki önermelerden çıkarma yöntemi, kendisine atfedilen "geometrinin babası" sözünü de haklı kılar.
- Kitapta yer alan aksiyomlara, teoremlere ve ispatlara dayanan sentez yöntemlerinin Batı düşüncesi üzerindeki etkisinin İncil'den sonra ikinci sırada yer aldığı söylenir.
- Öklid geometrisi 19. yüzyılın başına kadar rakipsiz kaldı. Hatta 20. yüzyılın ortalarına kadar bile orta öğretimde geometri, Öklid'in öğelerine

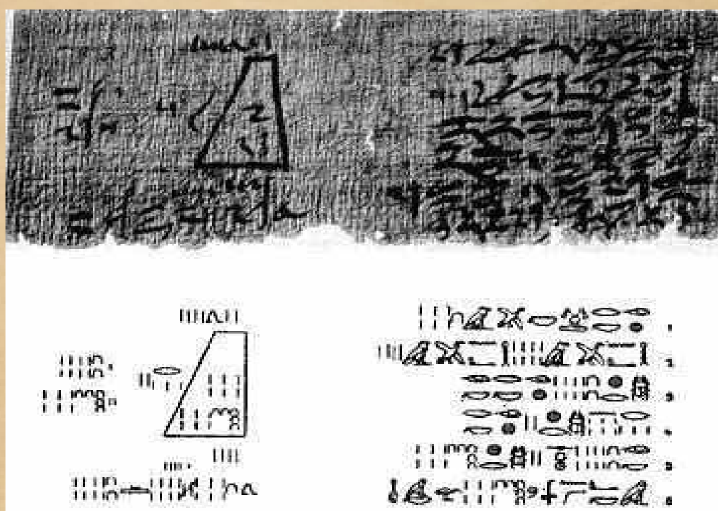
bağlı olarak okutuldu.Bu kitap hiçbir devirde alışılmamış bir duruluk ve kesinlikle kaleme alınmıştır.

Ek#4: Piramidin Hacmi ile İlgili Moscow Papirüsünde Yer Alan Soru

MOSCOW PAPİRÜSÜ

Rhind Papirüsü kadar meşhur olmasa da Mısırlılar döneminden kalma bir başka papirüs, *Moscow Papirüsü* olarak bilinen papirüstür. Bu papirüste de günlük uygulamaları içeren 25 adet problem vardır. Bu problemler arasında ekmek ve bira ile ilgili oranlara ilişkin olanlar ilgi çekicidir. Bu 25 problem arasında özellikle 14. sü o devirde Mısır matematiğinin ulaştığı noktayı göstermesi açısından çok önemlidir.

Moscow Papirüsünün 14. Problemi: Alt taban kenarı 4 br, üst taban kenarı 2 br, yüksekliği de 6 br olan bir tepesi kesik kare piramidin hacmini bulalım.



Ek#4: Piramidin Hacmi ile İlgili Moscow Papirüsünde Yer Alan Soru (Devam)

Plan yapalım:

Tepesi yarıdan kesilmiş bir kare piramidin hacminin hesaplanması isteniyor. Önce bu tepesi kesik piramidi bütün bir piramide tamamlayıp hacmini bulmalıyız. Daha sonra sonradan eklediğimiz üst kısımdaki küçük piramidin hacmini hesaplamalıyız. Hesapladığımız bu iki değerin farkını alıp kesik piramidin hacmini bulabiliriz.

Planı Uygulayalım:

(sınıfta uygulanır)

Kontrol edelim:

Problemi tekrar okuyarak verilen çözümü kontrol edelim.

(Papirüs'teki cevabı):

Hesaplama taban alanının hesaplanmasıyla başlar: 4.4 = 16. Sonra üst tabanın alanı hesaplanmaktadır: 2.2 = 4. Bundan sonra da tabanların kenar uzunlukları çarpılmıştır: 2.4 = 8. Bu üç sayı toplanmış ve 16 + 4 + 8 = 28 bulunmuştur. Son olarak ta yüksekliğin üçte biri olan 2, bulunan bu sonuçla çarpılmıştır ve papirüste "sonuç 56'dır" diye belirtilmiştir

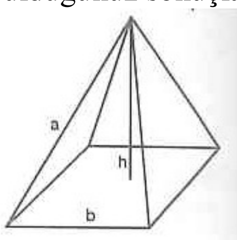
Ek#5: **Piramidin Hacmi ile İlgili Uygulama (MEB, 2009)**

8. Tabanı düzgün altıgensel bölgeden oluşan dik piramidinin cisim yüksekliği 10 cm ve bir kenarının uzunluğu 5 cm olduğuna göre hacminin kaç santimetreküp olduğunu bulunuz.

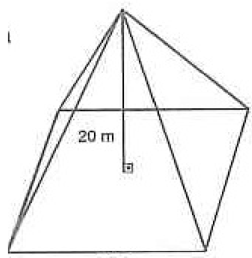
9. Bir dik kare piramidin yüzey alanı 192 cm^2, taban alanı 144 cm^2 ise hacmini bulunuz.

10. Yükseklik uzunluğu tabanının bir kenarının uzunluğunun üç katı olan kare dik piramidin hacmini harfli ifadeler kullanarak yazınız.

11. Dikdörtgen dik piramidin boyutları, a=3,8 cm, b= 6,3 cm, h=9,1 cm'dir. Bu piramidin hacmini tahmin ediniz. Tahmini bulduğunuz sonuçla karşılaştırınız.



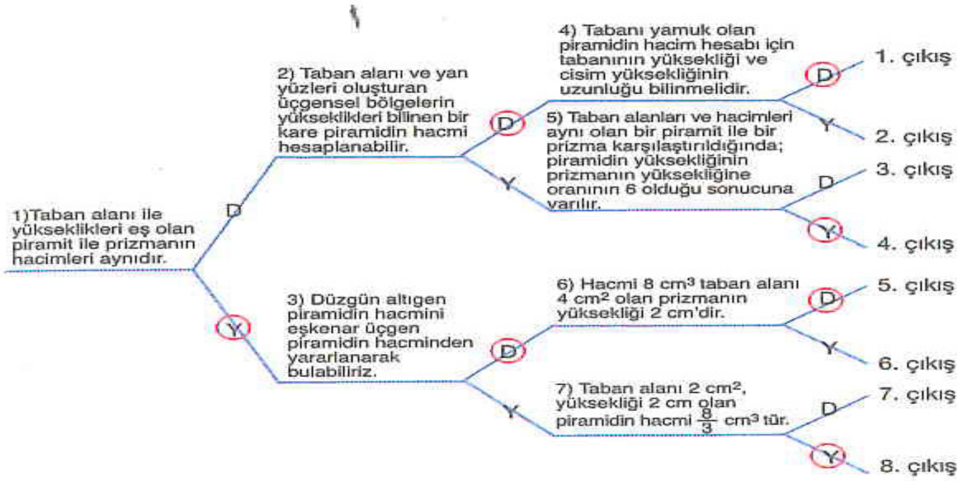
12. Aşağıdaki şekilde verilen kare dik piramit şeklindeki depoya 300 m^3 buğday konulduğunda deponun yarısı dolmuştur. Depoda daha önce kaç metreküp buğday vardır?



13. Aşağıdaki değerleri ve kelimeleri kullanarak bir problem kurunuz ve çözünüz.

    a= 6 m.
    b= 8 m.

14. Aşağıda birbiriyle bağlantılı doğru / yanlış cümleler verilmiştir. Şemadaki cümlelerde doğru olduğu belirtilen yargı yanlış, yanlış olduğu belirtilen yargı doğru olabilir. Her bir doğru / yanlış kararı sizi farklı çıkışlara ulaştırır ve alacağınız puanı etkiler. Buna göre aşağıdaki çıkışlardan birine ulaşınız.


1)Taban alanı ile yükseklikleri eş olan piramit ile prizmanın hacimleri aynıdır.
2) Taban alanı ve yan yüzleri oluşturan üçgensel bölgelerin yükseklikleri bilinen bir kare piramidin hacmi hesaplanabilir.
3) Düzgün altıgen piramidin hacmini eşkenar üçgen piramidin hacminden yararlanarak bulabiliriz.
4) Tabanı yamuk olan piramidin hacim hesabı için tabanının yüksekliği ve cisim yüksekliğinin uzunluğu bilinmelidir.
5) Taban alanları ve hacimleri aynı olan bir piramit ile bir prizma karşılaştırıldığında; piramidin yüksekliğinin prizmanın yüksekliğine oranının 6 olduğu sonucuna varılır.
6) Hacmi 8 cm³ taban alanı 4 cm² olan prizmanın yüksekliği 2 cm'dir.
7) Taban alanı 2 cm², yüksekliği 2 cm olan piramidin hacmi 8/3 cm³ tür.
D
Y
1. çıkış
2. çıkış
3. çıkış
4. çıkış
5. çıkış
6. çıkış
7. çıkış
8. çıkış

<table>
<tr><td>Öğretmen: Özlem ALBAYRAK</td><td>Sınıf Seviyesi: 8
Ders: Matematik</td><td>Ünite 5: Geometrik Cisimlerde Ölçme ve Perspektif</td><td>Tarih: May 2010
Süre: 3 ders saati</td></tr>
<tr><td>Konu – Alt konu:
• Geometrik Cisimlerin Hacimleri
    o Dik Dairesel Koninin Hacmi</td><td colspan="2">Kazanımlar:
9. Dik dairesel koninin hacim bağıntısını oluşturur.
10. Geometrik cisimlerin hacimleri ile ilgili problemleri çözer ve kurar.</td><td>Araç ve Gereç: kağıt, pergel, makas, cetvel, yapıştırıcı, kum

Ekler: (Ek#6)</td></tr>
<tr><td colspan="4">Ön koşullar:
• Silindirde taban, yükseklik gibi kavramları şekil üzerinde gösterebilme
• Silindirin hacim bağıntısını bilme
• Silindirin hacim bağıntısını kullanabilme</td></tr>
<tr><td colspan="4">Öğretici Aktiviteler- 4. ders</td></tr>
<tr><td>Zaman</td><td colspan="3">Ders</td></tr>
<tr><td>15 dakika

15 dakika</td><td colspan="3">Piramitlerin hacmi ile ilgili uygulama sorularına (Ek#5) devam edilir.

Koninin hacmini anlamak için gerekli olan önkoşul bilgiler şu şekilde pekiştirilir:

Öğrencilere verilmiş olan “Pretest- Volume” (TVpre) de uygulama konularıyla ilgili önkoşul bilgileri sorgulayan soruların olduğu ikinci kısımdan koni ile ilgili önkoşulu olan sorular sınıfta cevaplandırılır. Böylece öğrenciler koninin hacmini öğrenebilmek için gerekli olan silindirin hacim bağıntısı, hacim formülü, silindirin temel elemanları ve verilen değerlerle silindirin hacmini bulma ile ilgili önbilgilerini pekiştirmiş olurlar. Öğretmen her soru için istekli bir öğrenciyi tahtaya kaldırır ve ilgili sorular çözülür. Bu yolla tüm sınıfın eksik bilgilerini gidermeleri sağlanır.</td></tr>
</table>

10 dakika	Aşağıdaki metin ve resim sunum şeklinde ekrana yansıtılır. Bu etkinlik okutularak öğrencilerden bir dondurma külahının boyutlarını tahmin etmeleri ve bu tahmin doğrultusunda külahın hacmini hesaplamaları beklenir. Bu etkinliğin cevabıyla ilgili sınıfta bir tartışma ortamı yaratılır. Dondurma külahının hacmini hesaplayabilmek için dik dairesel silindirin hacim bağıntısına ihtiyaç olduğu hissettirilir. Bu bağıntıyı oluşturmak için de silindirin hacim bağıntısından nasıl yararlanılabileceği sorulur. Tarihi çok eski zamanlara dayanan dondurma, insanların serinlemek, ferahlamak ve mutlu olmak için kar, çeşitli meyveler ve bal karışımından elde ettikleri bir yiyecekti. Günümüzde süt ve meyvelerden hazırlanan dondurmalar genellikle külahlarla servis edilir. İçine konan dondurmanın eriyip ağzına kadar doldurduğu bir dondurma külahının hacmini hesaplaya bilirmisiniz? 

Ölçme *:*

Öğretmenin uygulama soruları sırasında öğrencilerin aralarında gezmesi ve onlara yardımcı olması, kimlerin ne kadar anladıklarını ölçmesi açısından önemlidir. Her öğrenci çözme hızı ve seviyesine göre soruları çözer. Kalan soruların ev ödevi olarak çözülmesi istenir. Böylece, daha yavaş çözebilen ya da daha yavaş anlayan öğrenciler evde vakit ayırarak diğer arkadaşlarına yetişebilirler.

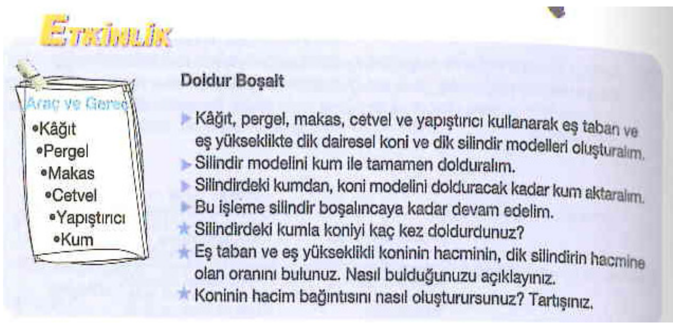
Öğretmen öğrenciler gerekli önkoşul bilgilerini cevaplarken sınıf içinde gezinir ve öğrencilerin cevaplarını kontrol eder. Anlamadıkları yerler ya da soruları olursa öğrencilere birebir yardımcı olur. Her soru tahtada cevaplandıktan sonra özet bir cümle kurarak cevabı pekiştirir.

Öğretmen derse hazırlık etkinliği sırasındaki sunum ve soruları ve koninin hacmiyle ilgili problemin cevabıyla ilgili tartışmayı yönlendirir, öğrencilerin katılımını sağlar.

<table>
<tr><th colspan="2">Öğretici Aktiviteler- 5. ders</th></tr>
<tr><td>Zaman</td><td>Ders</td></tr>
<tr><td>30 dakika</td><td>
Öğretmen etkinliğe başlamadan aşağıdaki açıklamayı yapar: Önceki dersimizde öğrendiğimiz gibi Öklit, “Elementler” adlı kitabında piramidin hacmiyle ilgili bilgilerin yanı sıra koninin hacminin bulunmasıyla ilgili de bilgi vermiştir. Bildiğimiz gibi, o günlerde prizmanın ve silindirin hacmi bilinmekteydi. Öklit, bu bilgileri kullanarak prizma ve koninin hacminin bulunması ile ilgili bilgiler vermiştir.

Öğrencilere aşağıdaki etkinlik yaptırılır. Bu sayede öğrencilerin kendilerini tarihteki bir matematikçinin yerine koyup dik dairesel koninin hacim bağıntısını oluşturabilmeleri ve koninin hacmini strateji kullanarak tahmin edebilmeleri amaçlanmıştır

Öğretmen aşağıdaki yönlendirmeyi yapar:
Aşağıdaki etkinlikte de Öklit’e koninin hacmini bulmasında yardım edelim. Bakalım “Elementler” adlı kitabındaki koninin hacmi ile ilgili bulduğu sonuca ulaşabilecek miyiz?

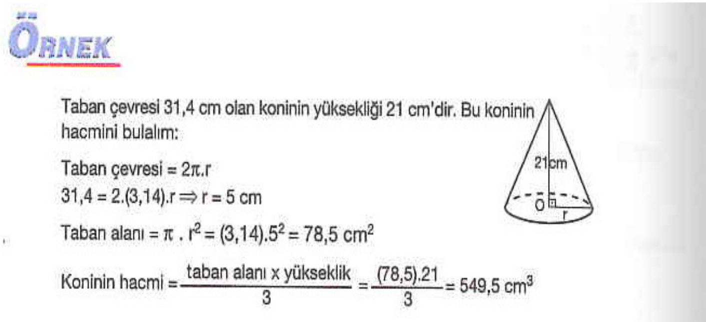

ETKİNLİK
Araç ve Gereç
•Kâğıt
•Pergel
•Makas
•Cetvel
•Yapıştırıcı
•Kum
Doldur Boşalt
▸ Kâğıt, pergel, makas, cetvel ve yapıştırıcı kullanarak eş taban ve eş yükseklikte dik dairesel koni ve dik silindir modelleri oluşturalım.
▸ Silindir modelini kum ile tamamen dolduralım.
▸ Silindirdeki kumdan, koni modelini dolduracak kadar kum aktaralım.
▸ Bu işleme silindir boşalıncaya kadar devam edelim.
★ Silindirdeki kumla koniyi kaç kez doldurdunuz?
★ Eş taban ve eş yükseklikli koninin hacminin, dik silindirin hacmine olan oranını bulunuz. Nasıl bulduğunuzu açıklayınız.
★ Koninin hacim bağıntısını nasıl oluşturursunuz? Tartışınız.

Bu etkinlikten sonra öğrencilerden silindirin hacminin koninin hacmine oranını tahmin etmeleri ve bu tahminlerini sınıfa açıklamaları istenir. Koninin hacim bağıntısıyla ilgili sınıfta tartışma ortamı oluşturulur ve gruplar fikirlerini paylaşırlar.

Öğretmen öğrencilerin cevaplarını aldıktan sonra Öklit’in kitabındaki sonucu sınıfla paylaşır:

Dik koninin hacmi, kendisine eş tabana ve yüksekliğe ait silindirin hacminin üçte biridir.
</td></tr>
</table>

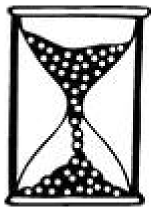
<table>
<tr><td></td><td>Öklit bu konuyla ilgili formül oluşturmamıştır. Silindirin hacim formülünü kullanarak bir formül oluşturacak olursak söyle olur:

Koninin hacmi: (taban alanı X yükseklik) / 3 = ($\prod$×r^2×h) /3</td></tr>
<tr><td>10 dakika</td><td>Aşağıdaki örnek soru sınıfa inceletilir. Koninin hacminin bulunuşu bir örnek üzerinde görülür. Öğretmen sorunun adımlarını tahtadan anlatır.

ÖRNEK
Taban çevresi 31,4 cm olan koninin yüksekliği 21 cm'dir. Bu koninin hacmini bulalım:
Taban çevresi = 2π.r
31,4 = 2.(3,14).r ⇒ r = 5 cm
Taban alanı = π . r^2 = (3,14).5^2 = 78,5 cm^2
Koninin hacmi = $\frac{\text{taban alanı x yükseklik}}{3} = \frac{(78,5).21}{3}$ = 549,5 cm^3

Bu etkinlik ve örnekten sonra öğretmen öğrencilerin buldukları aşağıdaki bağıntıyı özet şeklinde tekrar eder.

Dik koninin hacmi, eş taban ve yüksekliğe sahip silindirin hacminin üçte biridir.
Koninin hacmi = silindirin hacmi / 3</td></tr>
<tr><td colspan="2">Ölçme : “Doldur Boşalt” etkinliğinde öğrencilerin sıra arkadaşlarıyla grup halinde çalışması takip edilir. Öğretmen etkinlik sırasında sınıf içerisinde gezinir ve ilgili soruları cevaplandırır.
Öğretmen sınıf içi tartışmayı yönlendirir ve öğrencilerin katılımını sağlar.</td></tr>
<tr><td colspan="2">Öğretici Aktiviteler- 6. ders</td></tr>
<tr><td>Zaman</td><td>Ders</td></tr>
</table>

10 dakika	Yukarıdaki etkinlik ve örnekten sonra aşağıda, öğrencilere konilerle ilgili Öklit'ten sonra daha detaylı çalışan bir bilim adamıyla ilgili bilgi verilir. Konilerle ilgili daha derinlemesine çalışmaları Apollonius yapmıştır. Bu konuda aşağıdaki metin sunumda gösterilir. Apollonius, Öklit'in konilerle ilgili çalışmalarını benimsemiş ve bunu daha ileri düzeylere götüren çalışmalar yapmıştır. Bu konuda günümüze kadar gelen M.Ö. 225 yıllarında konikler adlı kitabı yazmıştır. Apollonius, zamanında çok bilinmeyen fakat değeri 1600 lü yıllarda anlaşılan Yunanlı bir matematikçiydi. Mısır'a giderek Öklit' ten sonra gelen matematikçilerden dersler alarak kendini geliştirmiştir. Tümü geometriye ait sekiz kitabı vardır. Koniklere ait buluşları onu şöhretin zirvesine çıkarmıştır. Konikler, koninin bir düzlemle kesitinden meydana gelen eğriler olarak tanımlanır.
15 dakika	Tarihte konilerle ilgili çalışmalar yapmış Apollonius ve yine tarihi eskilere dayanan bir obje olan kum saati kullanılarak bu bilim adamının yer aldığı bir problem çözelim ve kuralım etkinliği yaptırılır. Problem Çözelim ve Kuralım Yapılan araştırmalara göre saatin ilk ortaya çıktığı yer, M.Ö. 4000 senelerinde Mısır'dır. İlk saat güneşin dik duran bir cisimde meydana getirdiği gölgenin boyu esas alınarak yapılmıştır. Londra'daki müzede Kleopatra'nın bu şekilde bir saati sergilenmektedir. Güneş saati, gece iş görmediği için bunun yanında su veya kum saatleri de yapılmıştır. Kum saati, iki hazneli olup, iki hazneyi birleştiren ince delikten kum akış hızı prensip alınmıştır. Apollonius, aşağıdaki şekildeki gibi iki tane birbirine eş koni şeklindeki hazneden oluşan kum saatinin taban yarıçapını ölçmek istiyor. Toplam boyu 18 cm. olan bu kum saatinin alt hazesi yüksekliğinin üçte ikisine kadar kum ile doludur. Alt haznedeki kumun ağırlığı 1920 gr.dır. Kumun özkütlesini 3,2 g/cm^3 olarak alırsak kum saatinin taban yarıçapı kaç cm. olur? (∏= 3)

<table>
<tr>
<td></td>
<td>

Öğrencilere bu problemi çözmeleri için nasıl bir plan takip edecekleri sorulur. Sınıfta bir tartışma ortamı yaratılır. Bu planlarını yazmaları ve ders sırasında uygulamaları istenir. Öğrenciler problemi çözdüğünde problemin cevabı tahtaya yansıtılır, bu cevap gönüllü bir öğrenci tarafından sınıfa açıklanır ve öğrencilerden cevaplarını kontrol etmeleri istenir.</td>
</tr>
<tr>
<td>15 dakika</td>
<td>Taş, koni, hacim, 8 cm, 12 cm, M.Ö.

Öğrencilerden yukarıdaki verleri kullanarak bir problem kurmaları daha sonra bunu çözmeleri ve bu sırada da tarihle ilişkilendirerek problemi kendileri için daha eğlenceli hale getirmeleri amaçlanmıştır. Soruyu çözdükten sonra her öğrenci soru ve cevabını yanındaki sıra arkadaşıyla değiştirir ve arkadaşının problemini kontrol eder. Cevabın yanlış olduğunu düşündüklerinde arkadaşıyla birlikte sorunun cevabı üzerinde tekrar düşünürler ve anlamadıkları yer olursa öğretmene sorarlar.</td>
</tr>
<tr>
<td colspan="2">Ölçme : Öğretmen sınıf içi tartışmayı yönlendirir ve öğrencilerin katılımını sağlar.

Öğretmen öğrenciler problem üzerinde çalışırken sınıf içinde gezinir ve öğrencilerle enir. Anlamadıkları yerler ya da soruları olursa öğrencilere birebir yardımcı olur.</td>
</tr>
</table>

<table>
<tr><td>Öğretmen: Özlem ALBAYRAK</td><td>Sınıf seviyesi: 8
Ders: Matematik</td><td>Ünite 5: Geometrik Cisimlerde Ölçme ve Perspektif</td><td>Tarih:
May 2010
Süre:
2 ders saati</td></tr>
<tr><td>Konu – Alt konu:
• Geometrik Cisimlerin Hacimleri
  o Kürenin Hacmi</td><td colspan="2">Kazanımlar:
11. Kürenin hacim bağıntısını oluşturur.
12. Geometrik cisimlerin hacimleri ile ilgili problemleri çözer ve kurar.</td><td>Araç ve Gereç: kağıt, pinpon topu, makas, yapıştırıcı, kum

Ekler: (Ek#7) (Ek#8)</td></tr>
<tr><td colspan="4">Ön koşullar:
• Silindirde taban, yükseklik gibi kavramları şekil üzerinde gösterebilSilindirin hacim bağıntısını bilme
• Silindirin hacim bağıntısını kullanabilme</td></tr>
<tr><td colspan="4" align="center">Öğretici Aktiviteler- 7. ders</td></tr>
</table>

Zaman	Ders
25 dakika	Bu kısımdan sonra koninin hacmi ile ilgili uygulama sorularına geçilmektedir. Uygulama soruları öğrencilerin bu konuyla ilgili öğrendikleri problemlerden oluşmuştur. Uygulama soruları ders saatinde çözülmeye başlanır (Ek#6) Derste verilen sürede yetişmeyen sorular eve ödev verilir. Daha sonra doğruluğu kontrol edilir.
5 dakika	Kürenin hacmini anlamak için gerekli olan önkoşul bilgiler koninin hacmini bulmak için gerekli önkoşul bilgilerle aynıdır. Bu önkoşul bilgiler silindirin hacim bağıntısı, hacim formülü, silindirin temel elemanları ve verilen değerlerle silindirin hacmini bulma ile ilgili bilgilerdir. Koninin hacmi öğrenilmeden önce bu bilgiler tekrar edilmiştir. Bu yüzden öğretmen kısaca bu bilgileri özetler.
10 dakika	Aşağıdaki metin ve resim sunum şeklinde ekrana yansıtılır. Bu etkinlik okutularak öğrencilere bir cismin özkütlesini bulmak için o cismin ağırlığının hacmine bölünmesi gerektiği açıklanır.

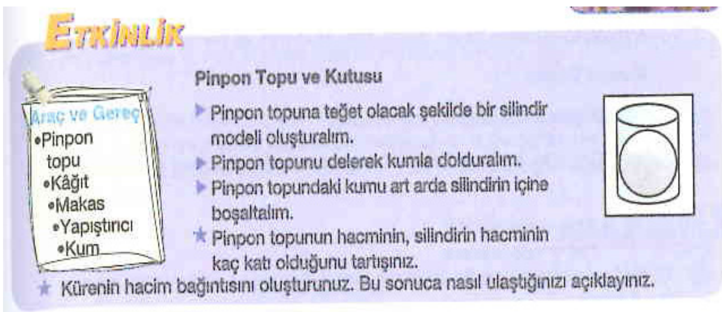
<table>
<tr><td></td><td>Öğrencilere bu işlem için bir kürenin hacminin hesaplanması gerektiği hissettirilir.
Bu etkinliğin cevabıyla ilgili sınıfta bir tartışma ortamı yaratılır.

</td></tr>
<tr><td colspan="2">Ölçme: Öğretmenin uygulama soruları sırasında öğrencilerin aralarında gezmesi ve onlara yardımcı olması, kimlerin ne kadar anladıklarını ölçmesi açısından önemlidir. Her öğrenci çözme hızı ve seviyesine göre soruları çözer. Kalan soruların ev ödevi olarak çözülmesi istenir. Böylece, daha yavaş çözebilen ya da daha yavaş anlayan öğrenciler evde vakit ayırarak diğer arkadaşlarına yetişebilirler.

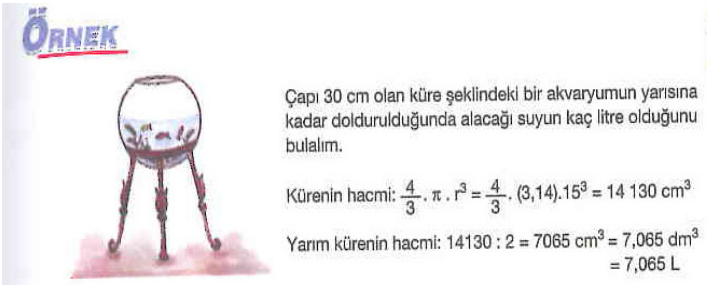
Öğretmen derse hazırlık etkinliği sırasındaki sunum ve soruları ve kürenin hacmiyle ilgili problemin cevabıyla ilgili tartışmayı yönlendirir, öğrencilerin katılımını sağlar.</td></tr>
<tr><td colspan="2">Öğretici Aktiviteler- 8. Ders</td></tr>
<tr><td>Zaman</td><td>Ders</td></tr>
<tr><td>15 dakika</td><td>Kürenin hacmini ilk olarak Arşimet hesap etmiştir. Öğrencilere sunumda Arşimet ve çalışmalarıyla ilgili bilgiler verilir. Arşimet'in değişik alanlarda çalışmalar yapan çok yönlü bir bilim adamı olduğu vurgulanır.

Sunumda Arşimet'in hayatı ve yaptığı çalışmalarla ilgili kısaca bilgi verilir (Ek#7). Böylece öğrencilerin öğrenecekleri konuya olan ilgileri arttırılmaya çalışılır.</td></tr>
<tr><td></td><td>Öğretmen "Pinpon Topu ve Kutusu" etkinliğine geçmeden önce şu açıklama ve yönlendirmeyi yapar:

Bir rivayete göre vasiyeti üzerine mezar taşına silindir içine sokulmuş bir küre çizilir.</td></tr>
</table>

20 dakika	Çünkü Arşimed'in en çok gurur duyduğunu söylediği çalışması budur; bir kürenin hacminin, içine tam olarak sığacağı silindirin hacmine oranı. Aşağıdaki etkinlikte Arşimet'in mezar taşına çizilmesini istediği bir şekil olan silindir içine tam olarak sığmış bir küre modelinin hacmini bulmak ve formülünü oluşturmak amaçlanmıştır. Şimdi kendinizi Arşimet'in yerine koyalım ve "Pinpon Topu ve Kutusu " etkinliğini yapalım. Bakalım Arşimet'in kürenin hacmi ile ilgili bulduğu sonuca ulaşabilecek miyiz? Öğrencilere aşağıdaki etkinlik yaptırılır. Bu sayede öğrencilerin kendilerini tarihteki bir matematikçinin yerine koyup kürenin hacim bağıntısını oluşturabilmeleri ve kürenin hacmini strateji kullanarak tahmin edebilmeleri amaçlanmıştır. Öğrenciler sıra arkadaşlarıyla grup halinde çalışırlar.  Bu etkinlikten sonra öğrencilerden silindirin hacminin kürenin hacmine oranını tahmin etmeleri ve bu tahminlerini sınıfa açıklamaları istenir. Kürenin hacim bağıntısıyla ilgili sınıfta tartışma ortamı oluşturulur ve gruplar fikirlerini paylaşırlar. Öğretmen öğrencilerin cevaplarını aldıktan sonra Arşimet'in kürenin hacmiyle ilgili bulduğu sonucu sınıfla paylaşır: Kürenin hacmi, içine tam olarak sığdığı silindirin hacminin 2/3 sidir. Kürenin hacmi: $(4/3 \times \prod \times r^3)$
	Aşağıdaki örnek soru sınıfa inceletilir. Kürenin hacminin bulunuşu bir örnek üzerinde görülür. Öğretmen sorunun adımlarını tahtadan anlatır.

5 dakika



Bu etkinlik ve örnekten sonra öğretmen öğrencilerin buldukları aşağıdaki bağıntıyı özet şeklinde tekrar eder.
Bir dik koninin hacmi, eş taban ve yüksekliğe sahip silindirin hacminin üçte biridir.
Koninin hacmi = Silindirin hacmi / 3

Ölçme :
Öğretmen derse hazırlık etkinliği sırasındaki sunum ve sorular ile ilgili tartışmayı yönlendirir. Konuyla ilgili matematik tarihi bilgileri vererek öğrencilerin derse olan motivasyonlarını arttırır.
"Pinpon Topu ve Kutusu" etkinliğinde öğrencilerin sıra arkadaşlarıyla grup halinde çalışması takip edilir. Öğretmen etkinlik sırasında sınıf içerisinde gezinir ve ilgili soruları cevaplandırır.

Öğretici Aktiviteler- 9. Ders

Zaman	Ders
	Kürenin hacim formülünü öğrendikten sonra problem çözelim ve kuralım etkinliği yaptırılır: Öğrencilere Arşimet'in hem sıvıların kaldırma kuvveti hem de kürenin hacmiyle ilgili bilgilerini uygulayabilecekleri problem çözelim kuralım etkinliği yaptırılır. ***Problem Çözelim ve Kuralım*** *Syracusa İtalya'da Sicilya Adası'nın güneyinde bir kent devletidir. Bu devletin kralı Kral Hieron kuyumcularına altından bir taç ısmarlamıştır. Taç kısa sürede işlenir ve getirilir. Ne var ki sarayın kuyumcularının altına gümüş karıştırdıklarından şüphe edilmektedir. Kral, çok sevdiği ve güvendiği bilge adamı, Arşimet'i çağırır, durumu anlatır ve*

15 dakika	*"Tacımın saf altından olup olmadığını anlayabilir misin?" diye sorar. Bu, o günün şartlarında çok zor bir problemdir. Çünkü olay milattan önceki yıllarda geçmektedir. Yani bundan yaklaşık 2200 yıl kadar önce. Arşimet sorunun yanıtını günlerce düşünür. Kafası bu soruyla meşgulken, Arşimet bir gün hamama gider ve yıkanırken suyun üzerinde yüzen tasa musluktan yavaş yavaş su akarken, tas suyla tamamen dolduğu anda hemen suya batar. Bunu gören Arşimet, "Eureka, Eureka" yani ""Buldum, Buldum" diyerek hamamdan dışarı fırlar. Arşimet'in buldum buldum dediği sıvıların kaldırma kuvvetine ilişkin önemli bir kanundur. Yani, bir sıvıya batırılan her cisim, yerini değiştirdiği sıvının ağırlığı kadar kendi ağırlığından kaybeder. O halde Arşimet artık kralın sorusunu çözebilir. Kralın tacının üst kısmındaki küre şekilli küçük süslerden birini alıp tacın gerçek altın olup olmadığıyla ilgili denemesini yapabilirdi. Bu süsün tamamı saf altında ise tacın da saf altın olduğu sonucuna ulaşacaktı.* Arşimet önce bir kenar uzunluğu 10 cm. olan tamamen su dolu küp şeklindeki bir kaba kralın tacından altığı küre şeklindeki süsü atıyor. Tamamen batan bu süs kabın hacminin yarısı kadar suyu dışarı taşırıyor. Daha sonra kuyumcuya kralın tacındaki süsle eşit yarıçapa sahip saf altından bir küre yaptırıyor ve bu kürenin de eşit miktarda su taşırıp taşırmadığına bakıyor. Bu durumda: a) Arşimet'in yaptırdığı saf altından olan kürenin yarıçapını bulunuz. ($\prod = 3$) b) Arşimet'in yaptırdığı saf altında olan küre kralın tacından alından eşit yarıçaplı süs küreye göre kaptan daha fazla su taşırmışsa kralın kuyumcusu kralı kandırmış mıdır? Problemi Anlayalım: Küp şeklindeki kaba önce tacın küre şeklindeki süsü atılıyor ve taşan suyun hacmi veriliyor. Daha sonra saf altından olduğu bilinen süsle eşit yarıçaplı küre atılıyor ve daha fazla su taşırdığı görülüyor. Bu durumda saf altından olan kürenin yarıçapı ve tacın tamamen saf altından yapılıp yapılmadığı soruluyor.

<table>
<tr>
<td></td>
<td>
Öğrencilere bu problemi çözmeleri için nasıl bir plan takip edecekleri sorulur. Sınıfta bir tartışma ortamı yaratılır. Bu planlarını yazmaları ve ders sırasında uygulamaları istenir. Öğrenciler problemi çözdüğünde problemin aşağındaki cevabı tahtaya yansıtılır, bu cevap gönüllü bir öğrenci tarafından sınıfa açıklanır ve öğrencilerden cevaplarını kontrol etmeleri istenir.</td>
</tr>
<tr>
<td>10 dakika</td>
<td>Öğrencilerden aşağıdaki verileri kullanarak bir problem oluşturmaları ve daha sonra da bunu çözmeleri istenir.
Ayasofya, Mimar Sinan, kubbe, alan, hacim, 20 m

Bu soruyla öğrencilerin kendilerinin bir problem oluşturması ve daha sonra bunu çözmeleri ve bu sırada da tarihle ilişkilendirerek problemi kendileri için daha eğlenceli hale getirmeleri amaçlanmıştır. Soruyu çözdükten sonra her öğrenci soru ve cevabını yanındaki sıra arkadaşıyla değiştirir ve arkadaşının problemini kontrol eder. Cevabın yanlış olduğunu düşündüklerinde arkadaşıyla birlikte sorunun cevabı üzerinde tekrar düşünürler ve anlamadıkları yer olursa öğretmene sorarlar.</td>
</tr>
<tr>
<td>15 dakika</td>
<td>Bu kısımdan sonra uygulama sorularına geçilmektedir. Uygulama soruları öğrencilerin bu konuyla ilgili öğrendikleri problemlerden oluşmuştur. Uygulama soruları ders saatinde çözülmeye başlanır (Ek#8) Ders süresinde yetişmeyen sorular eve ödev verilir. Daha sonra doğruluğu kontrol edilir.</td>
</tr>
<tr>
<td colspan="2">Ölçme : Öğretmen sınıf içi tartışmayı yönlendirir ve öğrencilerin katılımını sağlar.

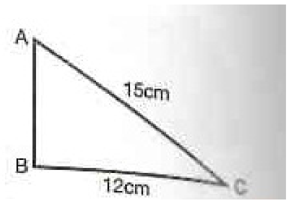
Öğretmen öğrenciler problem üzerinde çalışırken sınıf içinde gezinir ve öğrencilerle ilgilenir. Anlamadıkları yerler ya da soruları olursa öğrencilere birebir yardımcı olur.

Öğretmenin uygulama soruları sırasında öğrencilerin aralarında gezmesi ve onlara yardımcı olması, kimlerin ne kadar anladıklarını ölçmesi açısından önemlidir. Her öğrenci çözme hızı ve seviyesine göre soruları çözer.</td>
</tr>
</table>

Kalan soruların ev ödevi olarak çözülmesi istenir. Böylece, daha yavaş çözebilen ya da daha yavaş anlayan öğrenciler evde vakit ayırarak diğer arkadaşlarına yetişebilirler.

Ek#6: Koninin Hacmi ile İlgili Uygulama (MEB, 2009)

7. Aşağıdaki ABC dik üçgeni AB dik kenarı etrafında 180̊ döndürüldüğünde oluşan cismin hacmi kaç santimetreküptür?



8. Bir dik koninin taban alanı 25 cm^2 ve hacmi 100 cm^3 olduğuna göre yüksekliği kaç santimetrekaredir?

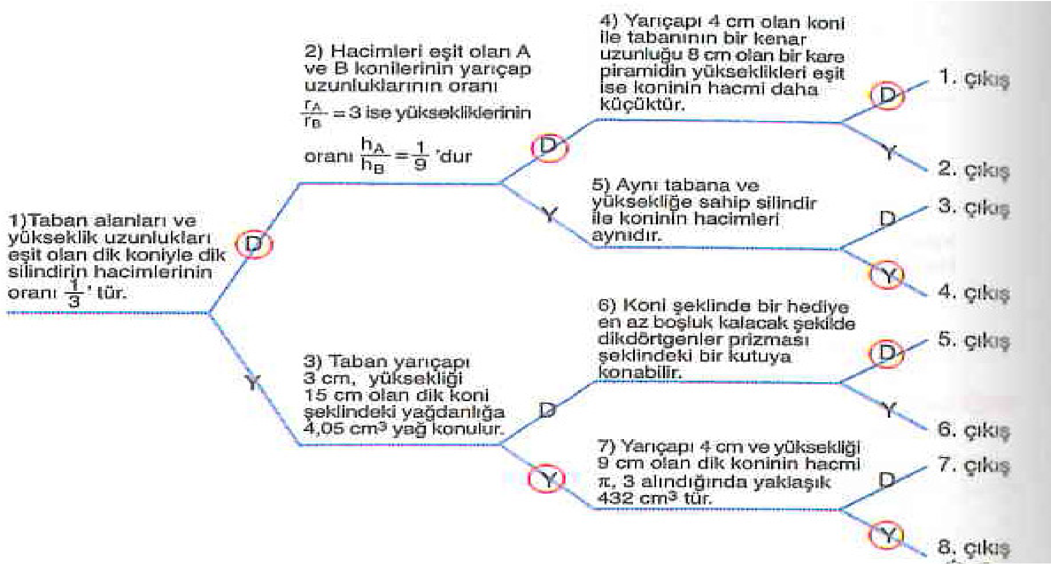
9. Bir dik silindirin içine taban çapı ve yüksekliğinin uzunluğu silindirin taban çapının ve yüksekliğinin uzunluğunun yarısı olan bir dik koni yerleştiriliyor. Koninin hacminin silindirin hacmine olan oranını bulunuz.

10. Yüksekliği 10 cm, taban yarıçapı 5 cm. olan dik koni şeklindeki bir kaba, bir kenarının uzunluğu 5 cm. olan küp şeklindeki kapla kaç kez su boşaltılırsa koni şeklindeki kap dolmuş olur? (∏=3 alınız) ?

11. Aşağıda yarıçapı ve yükseklik uzunlukları verilen dik konilerin hacimlerinin oranı hakkında ne söyleyebilirsiniz?
    a. r= 3 cm. h= 5 cm. b) r= 5 cm h= 3 cm

6. Yandaki verileri kullanarak bir problem kurunuz ve çözünüz. r= 2,5 cm
h = 3,5 cm

7. Aşağıda birbiriyle bağlantılı doğru / yanlış cümleler verilmiştir. Şemadaki cümlelerde doğru olduğu belirtilen yargı yanlış, yanlış olduğu belirtilen yargı doğru olabilir. Her bir doğru / yanlış kararı sizi farklı çıkışlara ulaştırır ve alacağınız puanı etkiler. Buna göre aşağıdaki çıkışlardan birine ulaşınız.



Ek#7: Arşimet'in Hayatı ve Çalışmaları ile İlgili Sunum (Sertöz, 1994)

- Arşimet'in değişik alanlarda çalışmalar yapan çok yönlü bir bilim adamıdır.

- Arşimet (Archimedes), M.Ö. 287 - 212 yılları arasında yaşamış Yunan uygarlığının ve eskiçağın en büyük matematikçilerinden biridir. Yaşadığı dönemde bilime ve bilim adamlarına çok önem verildiği ve bilimsel çalışmalar desteklendiği için parasal sıkıntı içinde kalmadan zamanını rahatlıkla ilime vermiştir.

- Arşimet, Mısır'ın İskenderiye kentine giderek orada Öklit'in derslerine devam etmiştir. Burada ilmi bilgisini geliştirdikten sonra ülkesine dönmüştür. Arşimet çok yönlü bir bilim adamıdır ve çeşitli alanlarda yaptığı çalışmalarla bilimsel gelişmelere katkıda bulunmuştur. Bu gelişmeleri kısaca söyle sıralayabiliriz:

  a) Mekanik Alanındaki Gelişmeler: Arşimet'e mekanik ilminin yaratıcısı gözüyle bakılır. İlkel insanlarda bile belki bir taşı veya herhangi bir ağırlığı yerinden kaldırıp başka bir yere yuvarlamak için odun ya da sopalar kullanılmıştır. Fakat kaldıraç kanunlarıyla evrenin bu sırrını çözen Arşimet olmuştur. Palangalar, dişliler, dişli çarklar ve daha birçok basit makineler hep onun buluşlarıdır. Denge konusundaki "Bana bir dayanak noktası verin, Dünyayı yerinden oynatayım" deyişi bu basit makinelerin değerinin büyüklüğünü gösterir.

  b) Sıvıların Kaldırma Kuvveti ile İlgili Çalışmaları: Arşimet bir gün hamama gitmiş ve yıkanırken suyun üzerinde yüzen tasa musluktan yavaş yavaş su akmaktaymış. Tas suyla tamamen dolduğu anda hemen suya batmış. Bunu gören Arşimet, "Eureka, Eureka" yani ""Buldum, Buldum" diyerek hamamdan dışarı fırlamıştır. Arşimet'in buldum buldum dediği sıvıların kaldırma kuvvetine ilişkin önemli bir kanunuydu. Yani, bir sıvıya batırılan her cisim, yerini değiştirdiği sıvının ağırlığı kadar kendi ağırlığından kaybeder.

c) Geometriyle İlgili Çalışmaları: Dairenin alanı, çemberin uzunluğu, kürenin yüzölçümü ve hacmini ilk kez Arşimet hesaplamıştır. Pi (∏) sayısının hesabı yine ona aittir. Alan ve hacim hesaplamalarında bulduğu yöntemler yüzyıllar boyu hep önde götürülmüştür. En karmaşık eğrilerle sınırlı alanları ve yüzeylerle sınırlı hacimlerin bulunma yöntemini o getirmiştir. Onun bu buluşları ve yöntemleri, Newton'a integral hesabın keşfedilmesine ilham vermiştir.

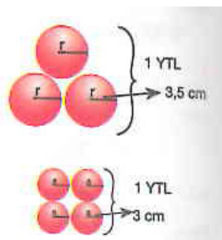
- Bir rivayete göre vasiyeti üzerine mezar taşına silindir içine sokulmuş bir küre çizilir. Çünkü Arşimed'in en çok gurur duyduğunu söylediği çalışması budur; bir kürenin hacminin, içine tam olarak sığacağı silindirin hacmine oranı.

Ek#8: Kürenin Hacmi ile İlgili Uygulama (MEB, 2009)

1. Büyük çemberinin çevresi 66 m. olan bir kürenin hacmini ve yüze alanını bulunuz.
2. Aşağıdaki yarıçapı 5 cm, yüksekliği 34 cm olam dik silindir şeklindeki fanusa, büyük dairesinin yarıçapı 4 cm olan dört adet küre şeklinde mavi bilye yerleştiriliyor. Fanus içinde kalan boşluğa ise beyaz renkli boncuklardan doldurularak masa süsü oluşturulmak isteniyor. Beyaz boncuklar kaç santimetreküp yere yerleşecektir? (∏=3)

3. r_1= 4 cm, r_2 = 8cm, misket, terazi verilerini kullanarak uygun bir problem kurarak çözümünü yapınız.

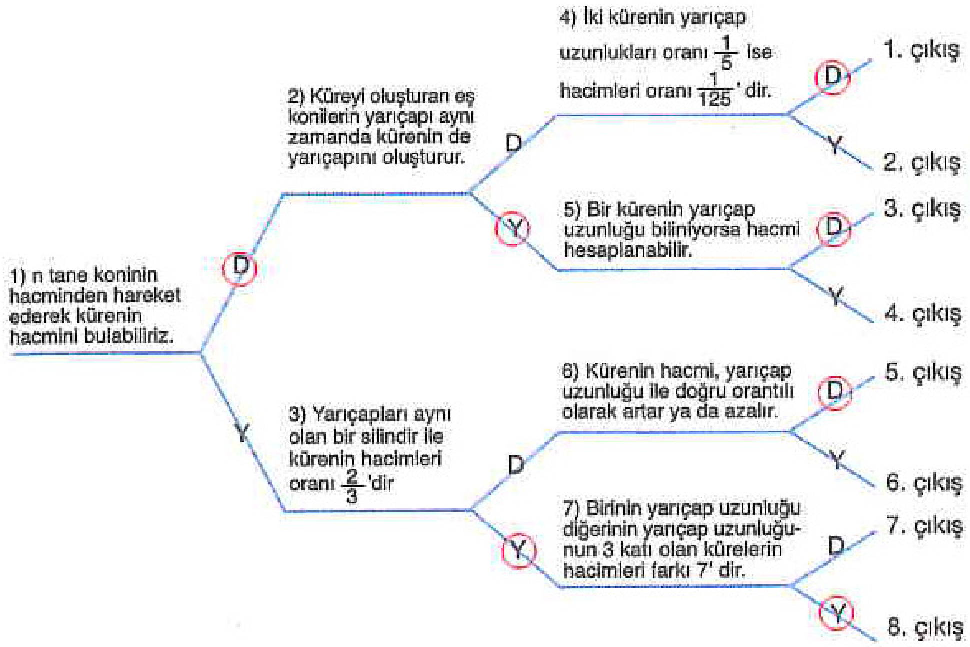
4. Aşağıda aynı kalitede küre şeklindeki elmaların boyutları ve her gruba ödenecek tutar yazılmıştır. Karlı bir alışveriş yapmak açısından hangi elma grubunu tercih edersiniz? Neden?



5. Aşağıdaki resimde küre şeklindeki bir kavunun yarısına ait kesit verilmiştir. Kavunun kabuklu iken yarıçapı 11 cm, kabuğu soyulduğunda ise yarıçapı 10 cm’dir. Yarın kavun şekilde gösterildiği gibi tepesinden 20° lik açılarla dilimlere ayrılacaktır. Buna göre ($\Pi=3$):
    a. Yarım kavun kaç dilime ayrılmış olur?
    b. Yarım kavunun hacmini bulunuz.
    c. Kabuksuz servis edilen bir kavun diliminin hacmini hesaplayınız.
    d. Bu kavun tüm olsaydı kabukları kaç cm^3 olurdu?

6. Yarıçapları oranı 3/5 olan iki kürenin hacimlerinin oranı bulunuz.

7. Aşağıda birbiriyle bağlantılı doğru / yanlış cümleler verilmiştir. Şemadaki cümlelerde doğru olduğu belirtilen yargı yanlış, yanlış olduğu belirtilen yargı doğru olabilir. Her bir doğru / yanlış kararı sizi farklı çıkışlara ulaştırır ve alacağınız puanı etkiler. Buna göre aşağıdaki çıkışlardan birine ulaşınız.



APPENDIX I: PERMISSION FROM MINISTRY OF NATIONAL EDUCATION OF TURKEY

T.C.
İSTANBUL VALİLİĞİ
İl Milli Eğitim Müdürlüğü

Sayı : B.08.4.MEM.4.34.00.18.580/50977 07.. Mayıs 2010
Konu : **Araştırma.**
(Özlem ALBAYRAK)

BOĞAZİÇİ ÜNİVERSİTESİ
Ortaöğretim Fen ve Matematik Alanları Eğitimi Bölümüne

İlgi: a-) 27/04/2010 tarih ve 101 sayılı yazınız.
b-) Valilik Makamının 06/05/2010 tarih ve 49796 sayılı Oluru.
c-) Milli Eğitim Bakanlığı Eğitim Araştırma ve Geliştirme Dairesi Başkanlığı'nın Okul ve Kurumlarda Yapılacak Araştırma ve Araştırma Desteğine Yönelik izin ve Uygulama Yönergesi.

Boğaziçi Üniversitesi Ortaöğretim Fen ve Matematik Alanları Eğitimi Alanları Eğitimi Bölümü Yüksek Lisans öğrencisi **Özlem ALBAYRAK'ın,** İlimizde ekte isimleri belirtilen okullarda uygulanmak üzere **"8. Sınıflarda Matematik Tarihiyle Desteklenen Öğretim Uygulamalarının Öğrencilerin Matematik Başarısı ve Matematiği Karşı Olan Özyeterlilik Algısı Üzerindeki Etkisi"** konulu anket çalışması yapma isteği ilgi (b) Valilik Oluru ile uygun görülmüştür.

Bilgilerinizi, gereğinin ilgi (b) Valilik Oluru doğrultusunda, gerekli duyurunun anketçi tarafından yapılmasını, işlem bittikten sonra 2(iki) hafta içinde sonuçtan Müdürlüğümüz Kültür Bölümüne rapor halinde bilgi verilmesini arz ederim.

Mustafa USLU
Müdür a.
Müdür Yardımcısı V.

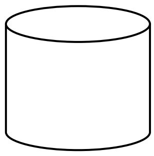
EKLER :
Ek-1. İlgi (b) Valilik Oluru.
Ek-2. Anket soruları.

APPENDIX J: RUBRIC FOR TEST- VOLUME-pre (TVpre)

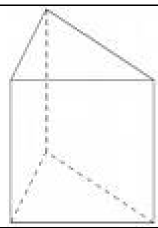
Hacim Kavramı Testi -1

2. Aşağıdaki tablodaki geometrik şekillerle ilgili boş kısımları doldurunuz.

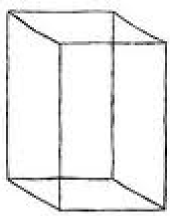
2a) 3 puan

	
Şeklin adı	Silindir (1 puan)
Taban şekli	Daire (1 puan)
Taban alanı	πr^2 (1 puan)

2b) 3 puan

	
Şeklin adı	Üçgen prizma (1 puan)
Taban şekli	Üçgen (1 puan)
Taban alanı	(a .b) / 2 (1 puan)

2c) 3 puan

	
Şeklin adı	Kare prizma (1 puan)
Taban şekli	Kare (1 puan)
Taban alanı	a^2 (1 puan)

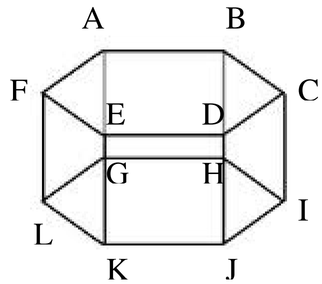
2a) sorusu için toplam 3 puandır. Her bir hücre için doğru cevap 1 puan, yanlış cevap 0 puandır.

2b) sorusu için toplam 3 puandır. Her bir hücre için doğru cevap 1 puan, yanlış cevap 0 puandır.

2c) sorusu için toplam 3 puandır. Her bir hücre için doğru cevap 1 puan, yanlış cevap 0 puandır.

3. Aşağıdaki altıgen dik prizmanın temel elemanlarına **a** seçeneğindeki gibi birer örnek veriniz.

a. Yükseklik= …[EK]………



(3 puan) 3bd) Yanal ayrıt = …[FL] / [EK] / [DJ] / [CI] / [BH] / [AG]…….

Yanal yüz = ….FEKL / EDJK / DCIJ / CBHI / BAGH / AFLG….

(3 puan) 3ce) Taban =…ABCDEF / GHIJKL….

Taban ayrıtı =…..[AB] / [BC] / [CD] / [DE] / [EF] / [FA] / [GH] / [HI] / [IJ] / [JK] / [KL] / [LG]…..

3bd) ve **3ce)** sorularının her biri için; 3 puan – her iki istenene de doğru cevap verilmişse 2 puan – yanal yüz / taban cevabı doğru, diğerleri yanlışsa 1 puan – yanal ayrıt / taban ayrıtı doğru, diğerleri yanlışsa 0 puan – her iki cevap da yanlışsa ya da boşsa

(3 puan) 4a) Dik prizmanın hacim bağıntısını formül kullanmadan bir cümle halinde açıklayınız.

Dik prizmanın hacmi taban alanı ile yüksekliğinin çarpımıdır.

3 puan : Tüm kavramlar ve işlem doğruysa 1 puan : Kavramlar doğru ancak işlem yanlışsa ya da kavramlardan bazıları yanlış ancak işlem doğru ise 0 puan : Tüm kavramlar ve işlem yanlışsa

(3 puan) 4b) Dik dairesel silindirin hacim bağıntısını formül kullanmadan bir cümle halinde açıklayınız.

Dik dairesel silindirin hacmi taban alanı ile yüksekliğin çarpımıdır.

3 puan : Tüm kavramlar ve işlem doğruysa 1 puan : Kavramlar doğru ancak işlem yanlışsa ya da kavramlardan bazıları yanlış ancak işlem doğru ise 0 puan : Tüm kavramlar ve işlem yanlışsa

(3 puan) 5)

(1 puan) Taban uzunluklarından biri **a**, yüksekliği **h** olan bir eşkenar üçgen dik prizmanın hacmini formül şeklinde yazınız.

$(a^2\sqrt{3}h)/4$

Formül doğru ise 1 puan Formül yanlış ise 0 puan

(1 puan) Taban uzunluğu **a**, yüksekliği **b** olan bir dik kare prizmanın hacmini formül şeklinde yazınız.

a^2b

Formül doğru ise 1 puan Formül yanlış ise 0 puan

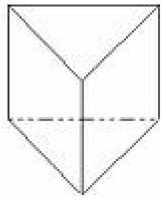
Yarıçapı **r**, yüksekliği **h** olan bir dik silindirin hacmini formül şeklinde yazınız.

$\Pi r^2 h$

Formül doğru ise 1 puan Formül yanlış ise 0 puan

6) Aşağıda verilen şekillerin hacimlerini bulup altlarındaki boşluklara yazınız.

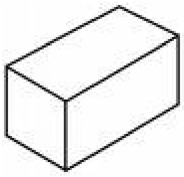
(3 puan) 6a)



V= (Taban Alanı) x Yükseklik

V= [(2 x 3) / 2] x 5 = 15 cm^3

(3 puan) 6b)



V= (Taban Alanı) x Yükseklik
V= (2 x 2) x (4,2) = 4 x (4,2) = 16,8 cm^3

(3 puan) 6c)

V= (Taban Alanı) x Yükseklik
V= $\Pi r^2 h = 3.\ 3^2.\ 5 = 135\ cm^3$

6a), 6b) ve 6c) soruları için;
3 puan – formül doğru, cevap doğru, işlem doğru ise

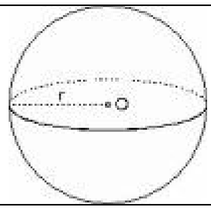
2 puan – formül doğru, sayılar formülde doğru ancak işlem hatası var ise

1 puan – formül doğru, ancak sayılar formülde doğru yerine konmadı ise

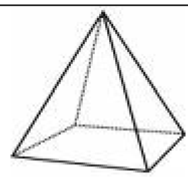
0 puan – formül yok ya da yanlış, veya cevap yok ise

7. Aşağıdaki tabloda gösterilen geometrik şekillerle ilgili boş kısımları doldurunuz.

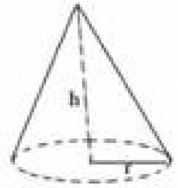
(3 puan) 7a)

	
Taban alanı	– (1 puan)
Yükseklik	– (1 puan)
Hacim	$4/3\Pi r^3 = 4/3.3.8 = 32\ cm^3$ (1 puan)

(3 puan) 7b)

	
Taban alanı	3. 3 = 9 cm^2 (1 puan)
Yükseklik	7 cm (1 puan)
Hacim	(9.7) / 3 = 21 cm^3 (1 puan)

(3 puan) 7c)

	 r = 3 cm h = 4 cm
Taban alanı	$3. 3^2 = 27$ cm^3 (1 puan)
Yükseklik	4 cm (1 puan)
Hacim	$27. 4 / 3 = 36$ cm^3 (1 puan)

7a, 7b, 7c sorularının her biri için toplam puan 3 puandır. Her bir hücre için doğru cevap 1 puan, yanlış cevap 0 puandır.

8. Aşağıdaki ifadelerden doğru olanların yanına **(D)**, yanlış olanların yanına **(Y)** yazınız.

(3 puan) 8ab)

(Y) Yarıçapları aynı olan bir silindir ile kürenin hacimleri oranı 2/3 tür.

(Y) Yüksekliği aynı kalmak koşuluyla hacmi yarıya düşen bir dik koninin taban yarıçapı da yarıya düşer.

3 puan – her iki ifade de doğru ise
2 puan – ikinci ifade doğru, birinci ifade yanlış ise
1 puan – birinci ifade doğru, ikinci ifade doğru ise
0 puan – her iki ifade de yanlış cevaplanmış ise

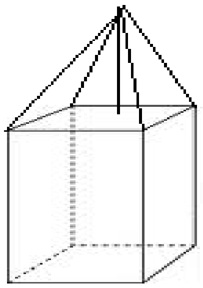
(3 puan) 8cd)

(D) Bir kare piramidin hacmi; tabanı ve yüksekliği bu piramidin tabanı ve yüksekliğine eşit olan bir kare prizmanın hacminin üçte birine eşittir.

(D) Konilerin hacim formülünden yararlanarak kürenin hacmini hesaplayabiliriz.

3 puan – her iki ifade de doğru ise
2 puan – ikinci ifade doğru, birinci ifade yanlış ise
1 puan – birinci ifade doğru, ikinci ifade doğru ise
0 puan – her iki ifade de yanlış cevaplanmış ise

(3 puan) 9ac) Aşağıda verilen şeklin hangi geometrik cisimlerden oluştuğunu altına yazınız.

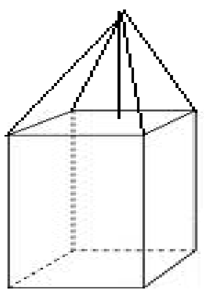


Dikdörtgen piramit

Dikdörtgen prizma

3 puan – her iki cisme de doru cevap verildiyse,
2 puan – bir cisme doğru, bir cisme yanlış cevap verildiyse,
1 puan – cisimlere yalnızca prizma ya da piramit cevapları verildiyse,
0 puan – cevap yok ya da yanlış ise

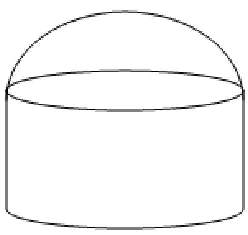
(3 puan) 9ad) Verilen değerleri kullanarak aşağıdaki şeklin hacmini bulunuz.



$V_{Prizma} = 3.4.7 = 84\ cm^3$
$V_{Piramit} = 3.4.5 / 3 = 20\ m^3$
$V_{Toplam} = 84 + 20 = 104\ m^3$

3 puan - V_{Prizma}, $V_{Piramit}$ ve V_{Toplam} doğru ise,
2 puan - V_{Prizma} ve $V_{Piramit}$ doğru ancak V_{Toplam} yanlış ise,
1 puan - V_{Prizma} ya da $V_{Piramit}$ ten sadece birisi doğru ise,
0 puan – cevap boş ya da tüm hacim hesaplamaları yanlış ise

(3 puan) 9bc) Aşağıda verilen şeklin hangi geometrik cisimlerden oluştuğunu altına yazınız.

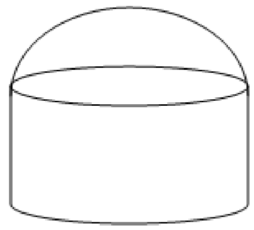


Yarım küre

Silindir

3 puan – her iki cisme de doru cevap verildiyse,
2 puan – bir cisme doğru, bir cisme yanlış cevap verildiyse,
1 puan – silindir adlı cisme yanlış cevap verildiyse ve yarım küre adlı cisme küre olarak cevap verildiyse,
0 puan – cevap yok ya da yanlış ise

(3 puan) 9bd) Verilen değerleri kullanarak aşağıdaki şeklin hacmini bulunuz.



$V_{Küre}$= 4/3. 3. 3 = 108 cm^3
$V_{Yarım\ küre}$ = 108/2 = 54 cm^3
$V_{Silindir}$ = 3.9.5 = 135 cm^3
V_{Toplam} = 54 + 135 = 189 cm^3

3 puan – $V_{Küre}$, $V_{Silindir}$ ve V_{Toplam} doğru ise,
2 puan – $V_{Küre}$ ve $V_{Silindir}$ doğru ancak V_{Toplam} yanlış ise,
1 puan – $V_{Küre}$ ya da $V_{Silindir}$ ten sadece birisi doğru ise,
0 puan – cevap boş ya da tüm hacim hesaplamaları yanlış ise

10. Aşağıdaki cümlelerdeki boşlukları doldurunuz.

(3 puan) 10a) Yükseklikleri aynı olan koni ve piramidin hacim bağıntılarının aynı olmasına rağmen sonucun farklı olmasının sebebi ……tabanlarının / taban alanlarının / taban şekillerinin farklı olması…..dır.

3 puan – cevap doğru ise,
0 puan – cevap yanlış ise

(3 puan) 10b) Bir dik koninin hacmi tabanı ve yüksekliği bu koninin tabanı ve yüksekliğine eş olan dik silindirin hacminin ……1/3 i ….. kadardır.

3 puan – cevap doğru ise,
0 puan – cevap yanlış ise

(3 puan) 10c) Yarıçapları oranı 2/5 olan kürelerin hacimleri oranı …8/125….olur.

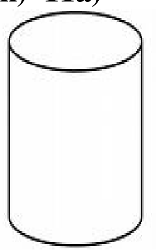
3 puan – cevap doğru ise,
0 puan – cevap yanlış ise

(3 puan) 10d) Taban ayrıtları 2 katına çıkıp, yüksekliği yarıya inen kare dik piramidin hacmi …2… katına çıkar.

3 puan – cevap doğru ise,
0 puan – cevap yanlış ise

11. Aşağıda taban yarıçapları ve yükseklikleri verilen dik dairesel koni, küre ve dik silindirlerden **hacimleri birbirine eşit** olanları eşleştiriniz.

(3 puan) 11a)

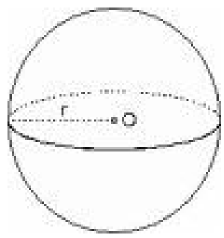


r= 3 cm
h= 6 cm

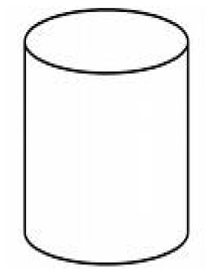
r= 3 cm
h= 18 cm

3 puan – iki cismin hacmi de doğru ise,
2 puan – koninin hacmi doğru, silindirin hacmi yanlış ise ya da yok ise,
1 puan – silindirin hacmi doğru, koninin hacmi yanlış ya da yok ise,
0 puan – silindirin hacmi de, koninin hacmi de doğru bulunamadıysa

(3 puan) 11b)



r = 3 cm

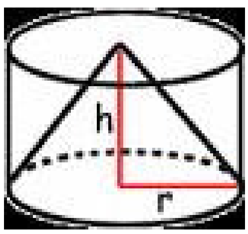


r = 2 cm
h = 9 cm

$V_{Küre} = 4/3 \, . \, 3. \, 27$
$V_{Küre} = 108 \text{ cm}^3$

3 puan – iki cismin hacmi de doğru bulunup doğru eşleştirildiyse,
2 puan – kürenin hacmi doğru, silindirin hacmi yanlış ise ya da yok ise,
1 puan – silindirin hacmi doğru, kürenin hacmi yanlış ya da yok ise,
0 puan – silindirin hacmi de, kürenin hacmi de doğru bulunamadıysa

(3 puan) 12) Aşağıdaki şekilde **tabanları çakışık, yükseklikleri eşit** bir koni ve bir silindir verilmiştir. Silindir ile koninin arasındaki boşluğun hacmi 48 cm^3 olduğuna göre koninin hacmi kaç cm^3 tür?



$V_{Koni} / V_{Silindir} = 1/3$

$V_{Boşluk} / V_{Silindir} = 2/3$

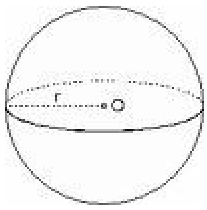
$V_{Boşluk} = 2 \, V_{Koni}$

$48 = 2 \, V_{Koni}$

$V_{Koni} = 24 \text{ cm}^3$

3 puan – doğru bağıntı, doğru işlem, doğru sonuç var ise,
2 puan – $V_{Boşluk} = 2\ V_{Koni}$ doğru bağıntısı var ancak sonuç yanlış ise,
1 puan – yalnızca $3V_{Koni} = V_{Silindir}$ bağıntısı var ise,
0 puan – tüm bağıntılar yanlış ya da cevap yok ise

(3 puan) 13) En büyük dairesinin alanı 108 cm^2 olan kürenin hacmi kaç cm^3 tür? (Π =3)



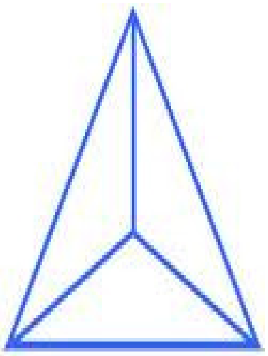
$\Pi r^2 = 108$
$3r^2 = 108$
$r^2 = 36$
$r = 6$ cm

$V_{Küre} = 4/3.\ 3.\ 216$

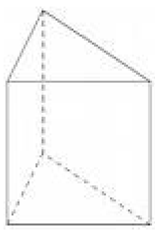
$V_{Küre} = 864$ cm^3

3 puan – hem r doğru, hem kürenin hacim formülü doğru, hem de hacim hesaplaması doğru bulunmuş ise,
2 puan – r doğru bulunmuş, kürenin hacim formülü doğru yazılmış, ancak kürenin hacmi yanlış hesaplanmışsa,
1 puan - $\Pi r^2 = 108$ yazılmış ancak r değeri doğru bulunamamışsa,
0 puan – cevap yok ya da yanlış ise

(3 puan) 14) Üçgen dik **piramidin** yüksekliği, hacmi 100 cm^3 olan üçgen dik **prizmanın** yüksekliğinin 3 katıdır. Bu cisimlerin tabanları eş ise üçgen dik piramidin hacmi kaç cm^3 tür?



3h



h

$V_{Prizma} = T_a\ .\ h = 100$ cm^3

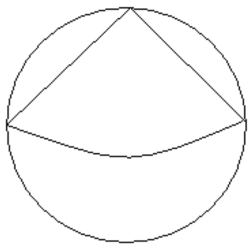
$V_{Piramit} = T_a.\ 3h\ /\ 3 = T_a\ .\ h$

$V_{Piramit} = V_{Prizma} = 100$ cm^3

Prizmanın hacmi, kendisiyle eşit taban ve yüksekliğe sahip piramidin hacminin 3 katıdır. Bu soruda tabanlar eş ancak piramidin yüksekliği prizmanın yüksekliğinin 3 katıdır. Dolayısıyla hacimleri eşittir.
$V_{Piramit} = 100$ cm^3

3 puan – hem bağıntı doğru, hem de $V_{Piramit} = V_{Prizma}$ eşitliği kurulabilmişse,
2 puan – bağıntı doğru ancak $V_{Piramit} = V_{Prizma}$ eşitliği kurulamamışsa,
1 puan – bağıntıda hata yapılmışsa,
0 puan – bağıntı yoksa ya da tamamen yanlışsa

(3 puan) 15) Tabanı kürenin en büyük dairesi olan ve tepesi kürenin üzerinde olan en büyük koninin hacmi 8 cm^3 tür. Bu koniyi içeren kürenin hacmi kaç cm^3 tür? (∏ = 3)

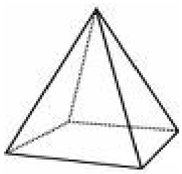


h = r = koninin yüksekliği
$V_{Koni} = (3.\ r^2.\ r\ ) / 3 = 8$
r = 2 cm

$V_{Küre} = 4/3.\ 3.8 = 32\ cm^3$

3 puan – formüller, işlemler ve cevap doğru ise
2 puan – formül doğru, h = r doğru ama sonuca giden işlem yanlışsa
1 puan – formül doğru ancak h = r bağıntısı bulunamadıysa
0 puan – formüller yanlış ya da yoksa

(3 puan) 16a) a= 4 cm., h= 6 cm.
Yukarıdaki verileri kullanarak **dik piramit ile ilgili şekil çiziniz.**



3 puan – şekil doğru, veriler şekil üzerinde doğru yerleştirilmişse,
2 puan – şekil doğru, veriler şekil üzerinde yanlış yerleştirilmişse,
1 puan – şekil doğru, veriler yerleştirilmemişse,
0 puan – şekil yoksa ya da yanlışsa

16b) a= 4 cm., h= 6 cm.
Yukarıdaki verileri kullanarak **dik piramidin hacmi** ile ilgili bir problem kurunuz.

Örnek cevap: Şekildeki kare dik piramit şeklindeki kutunun taban uzunluğu 4 cm, yüksekliği 6 cm ise hacmi kaç cm^3 tür?

3 puan – tüm veriler doğru kullanılarak bir soru yazılmışsa, 2 puan – bazı veriler doğru kullanılarak bir soru yazılmışsa, 1 puan – problem yazmadan sadece "a=4 cm, h=6 cm, ise V=?" yazılmışsa, 0 puan – problem yazılmamışsa ya da tamamen yanlışsa

(3 puan) 16c) a= 4 cm., h= 6 cm.
Yukarıdaki verileri kullanarak **dik piramidin hacmi** ile ilgili kurulan problemi çözünüz.

Örnek cevap : V = (Taban alanı x yükseklik) / 3
$V = (4^2 . 6) / 3 = 32 \text{ cm}^3$

3 puan – formül doğru, işlem doğru ve cevap doğru ise, 2 puan – formül doğru, işlem doğru ancak sonuç hatalı bulunduysa, 1 puan – formül doğru ancak işlemler hatalıysa, 0 puan – formül yanlış ya da cevap yoksa

(3 puan) 17a) Top, 16 cm., hacim verilerini kullanarak bir problem kurunuz.

Örnek cevap : Çapı 16 cm olan küre şeklindeki bir topun hacmi kaç cm^3 tür? (Π = 3)

3 puan – tüm veriler doğru kullanılarak bir soru yazılmışsa, 2 puan – bazı veriler doğru kullanılarak bir soru yazılmışsa, 1 puan – problem yazmadan sadece "r=16 cm ise V=?" yazılmışsa, 0 puan – problem yazılmamışsa ya da tamamen yanlışsa

(3 puan) 17b) Top, 16 cm., hacim verilerini kullanarak kurulan problemi çözünüz.

Örnek cevap : $V = (4/3. \Pi. r^3) = (4/3. 3. 8^3) = 4. 512 = 2048 \text{ cm}^3$

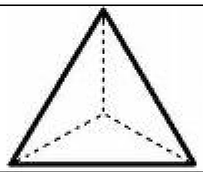
3 puan – formül doğru, işlem doğru ve cevap doğru ise, 2 puan – formül doğru, işlem doğru ancak sonuç hatalı bulunduysa, 1 puan – formül doğru ancak işlemler hatalıysa, 0 puan – formül yanlış ya da cevap yoksa

APPENDIX K: RUBRIC FOR TEST- VOLUME-post (TVpost)

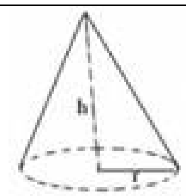
Hacim Kavramı Testi -2

1. Aşağıdaki tablodaki geometrik şekillerle ilgili boş kısımları doldurunuz.

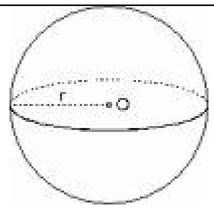
(3 puan) 1a)

	
Taban alanı	(3.4) / 2 = 6 cm^2 (1 puan)
Yükseklik	6 cm (1 puan)
Hacim	(6.6) / 3 = 12 cm^3 (1 puan)

(3 puan) 1b)

	
Taban alanı	Π. r^2 = 3. 4 = 12 cm^2 (1 puan)
Yükseklik	4 cm (1 puan)
Hacim	(12. 4) / 3 = 16 cm^3 (1 puan)

(3 puan) 1c)

	
Taban alanı	– (1 puan)
Yükseklik	– (1 puan)
Hacim	(4/3. 3. 125) = 500 cm^3 (1 puan)

1a, 1b, 1c sorularının her biri için toplam puan 3 puandır.
Her bir hücre için doğru cevap 1 puan, yanlış cevap 0 puandır.

2. Aşağıdaki ifadelerden doğru olanların yanına (D), yanlış olanların yanına (Y) yazınız.

(3 puan) 2ab) (Y) Hacimleri oranı 27/125 olan kürelerin yarıçapları oranı 9/25 tir.

(D) Taban alanları ve hacimleri aynı olan bir üçgen piramit ile üçgen prizma karşılaştırıldığında; piramidin yüksekliğinin prizmanın yüksekliğine oranının 3 olduğu sonucuna varılır.

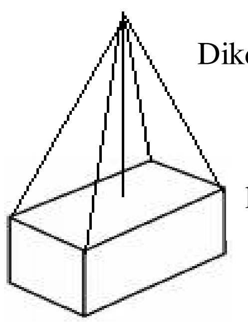
3 puan – her iki ifade de doğru ise 2 puan – birinci ifade doğru, ikinci ifade yanlış ise 1 puan – ikinci ifade doğru, birinci ifade doğru ise 0 puan – her iki ifade de yanlış cevaplanmış ise

(3 puan) 2cd) (D) Bir dik koninin hacmi; tabanı ve yüksekliği bu koninin tabanı ve yüksekliğine eşit olan bir silindirin hacminin üçte birine eşittir.

(Y) Piramitlerin hacim formülünden yararlanarak kürenin hacmini hesaplayabiliriz.

3 puan – her iki ifade de doğru ise 2 puan – ikinci ifade doğru, birinci ifade yanlış ise 1 puan – birinci ifade doğru, ikinci ifade doğru ise 0 puan – her iki ifade de yanlış cevaplanmış ise

(3 puan) 3ac) Aşağıda verilen şeklin hangi geometrik cisimlerden oluştuğunu altlarına yazınız



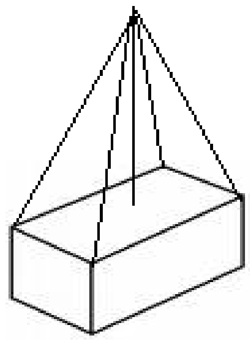
Dikdörtgen piramit

kare prizma

h = 5 m

3 puan – her iki cisme de doru cevap verildiyse, 2 puan – bir cisme doğru, bir cisme yanlış cevap verildiyse, 1 puan – cisimlere yalnızca prizma ya da piramit cevapları verildiyse, 0 puan – cevap yok ya da yanlış ise

(3puan) 3ad) Verilen değerleri kullanarak aşağıdaki şeklin hacmini bulunuz.

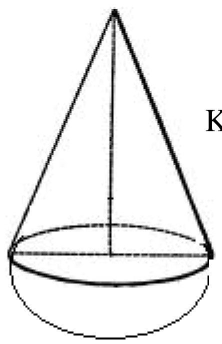


h = 5 m

V_{Prizma} = 2. 2. 2 = 16 m^3
$V_{Piramit}$ = 2.4.5 / 3 = 40/3 = 13,3 m^3
V_{Toplam} = 16 + 13,3 = 29,3 = 88/3 m^3

3 puan - V_{Prizma}, $V_{Piramit}$ ve V_{Toplam} doğru ise,
2 puan - V_{Prizma} ve $V_{Piramit}$ doğru ancak V_{Toplam} yanlış ise,
1 puan - V_{Prizma} ya da $V_{Piramit}$ ten sadece birisi doğru ise,
0 puan – cevap boş ya da tüm hacim hesaplamaları yanlış ise

3bc) Aşağıda verilen şeklin hangi geometrik cisimlerden oluştuğunu altlarına yazınız

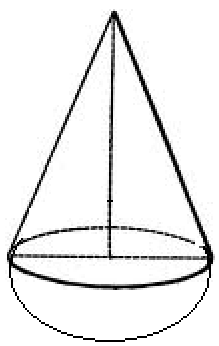


Koni

Yarım küre

3 puan – her iki cisme de doru cevap verildiyse,
2 puan – bir cisme doğru, bir cisme yanlış cevap verildiyse,
1 puan – koni adlı cisme yanlış cevap verildiyse ve yarım küre adlı cisme küre olarak cevap verildiyse,
0 puan – cevap yok ya da yanlış ise

3bd) Verilen değerleri kullanarak aşağıdaki şeklin hacmini bulunuz.



4. Aşağıdaki cümlelerdeki boşlukları doldurunuz.

(3 puan) 4a) Yükseklikleri aynı olan koni ve piramidin hacminin [(taban alanı×yükseklik) / 3] formülü kullanılarak bulunmasına rağmen sonucun farklı olmasının sebebi …….tabanlarının / taban alanlarının / taban şekillerinin farklı olması…...dır.

3 puan – cevap doğru ise, 0 puan – cevap yanlış ise

(3 puan) 4b) Yarıçapları aynı olan bir silindirin hacminin ile kürenin hacmine oranı…$(\Pi.r^2h) / (4/3\Pi r^3) = 3h / 4$…… tür.

3 puan – cevap doğru ise, 0 puan – cevap yanlış ise

(3 puan) 4c) En büyük çemberinin yarıçap uzunluğu r olan bir kürenin hacmi, taban yarıçapı r ve yüksekliği 2r olan dik silindirin hacminin …2/3 sine…eşittir.

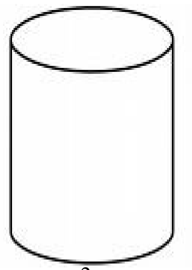
3 puan – cevap doğru ise, 0 puan – cevap yanlış ise

(3 puan) 4d) Bir dik koninin taban yarıçapı 4 katına çıkarılırsa, hacmi ….16…..katına çıkar.

3 puan – cevap doğru ise, 0 puan – cevap yanlış ise

5. Aşağıda taban yarıçapları ve yükseklikleri verilen dik dairesel koni, küre ve dik silindirlerden hacimleri birbirine eşit olanları eşleştiriniz.

(3 puan) 5a)

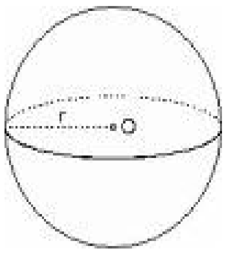


$\Pi.r^2.4r$ $\qquad$ $\Pi.4r^2.3r\ /3$

$4\ \Pi.r^3$ $\quad = \quad$ $4\ \Pi.r^3$

3 puan – iki cismin hacmi de doğru bulunup doğru eşleştirildiyse,
2 puan – koninin hacmi doğru, silindirin hacmi yanlış ise ya da yok ise,
1 puan – silindirin hacmi doğru, koninin hacmi yanlış ya da yok ise,
0 puan – silindirin hacmi de, koninin hacmi de doğru bulunamadıysa

(3 puan) 5b)

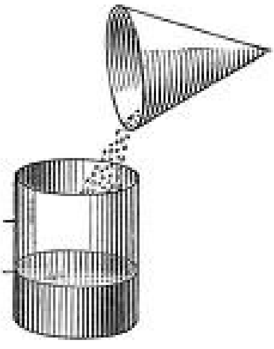


$(\Pi.r^2.4r)\ /\ 3$ $\qquad$ $4/3.\Pi.r^3$

$4/3.\Pi.r^3$ $\quad = \quad$ $4/3.\Pi.r^3$

3 puan – iki cismin hacmi de doğru bulunup doğru eşleştirildiyse,
2 puan – kürenin hacmi doğru, koninin hacmi yanlış ise ya da yok ise,
1 puan – koninin hacmi doğru, kürenin hacmi yanlış ya da yok ise,
0 puan – koninin hacmi de, kürenin hacmi de doğru bulunamadıysa

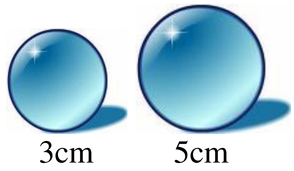
(3 puan) 6) İçi su dolu dik dairesel koni şeklindeki bir kabın yüksekliği 24 cm.dir. Kabın içindeki su, tabanı bu koni ile eş olan dik silindir şeklinde başka bir kaba boşaltıldığında suyun yüksekliği kaç cm. olur?

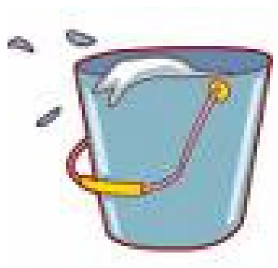


Eş tabana sahip koni ve silindirin hacimleri arasında $V_{Silindir} = 3V_{Koni}$ bağıntısı vardır. Bu durumda tabanlar eşit olduğu için yükseklikleri arasında da $3h_{silindir} = h_{koni}$ olur. Yani suyun silindirdeki yüksekliği $24 \div 3 = 8$ olur.

3 puan – doğru bağıntı, doğru işlem, doğru sonuç var ise,
2 puan – $3h_{silindir} = h_{koni}$ doğru bağıntısı var ancak sonuç yanlış ise,
1 puan – yalnızca $V_{Silindir} = 3V_{Koni}$ bağıntısı var ise,
0 puan – tüm bağıntılar yanlış ya da cevap yok ise

(3 puan) **7)** Yarıçapı 3 cm, ve 5cm olan içi dolu metal iki küre; içi tamamen su dolu bir kovanın içine atılıyor. Kürelerin taşırdığı suyun hacmi kaç cm^3 tür? ($\Pi = 3$)

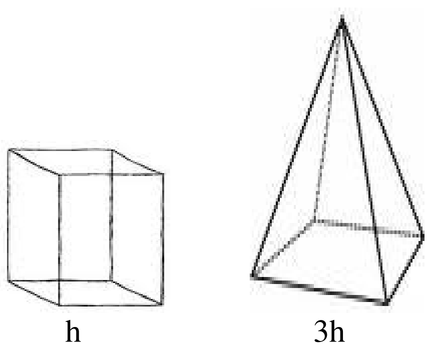




Küreler kovadan hacimleri oranında su taşırırlar.
$V_1 = 4/3.\ \Pi.\ 3^3 = 4/3.\ 3.\ 27 = 108\ cm^3$
$V_2 = 4/3.\ \Pi.\ 5^3 = 4/3.\ 3.\ 125 = 500\ cm^3$
$V_{toplam} = 108 + = 500 = 608\ cm^3$

3 puan – hem kürelerin hacim formülü doğru, hem de hacim hesaplaması doğru bulunmuş ise,
2 puan –kürenin hacim formülü doğru yazılmış, ancak kürelerden herhangi birinin hacmi yanlış hesaplanmışsa,
1 puan – kürenin hacim formülü doğru yazılmış ancak hesaplar doğru yapılamamışsa,
0 puan – cevap yok ya da yanlış ise

(3 puan) **8)** Hacmi 150 cm^3 olan kare dik prizmanın yüksekliği, kare dik piramidin yüksekliğinin 1/3 idir. Bu cisimlerin tabanları eş ise kare dik piramidin hacmi kaç cm^3 tür?



$V_{Prizma} = T_a\ .\ h = 150\ cm^3$

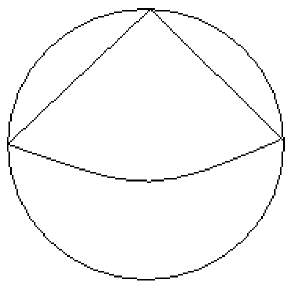
$V_{Piramit} = T_a.\ 3h\ /\ 3 = T_a\ .\ h$

$V_{Piramit} = V_{Prizma} = 150\ cm^3$

Prizmanın hacmi, kendisiyle eşit taban ve yüksekliğe sahip piramidin hacminin 3 katıdır. Bu soruda tabanlar eş ancak piramidin yüksekliği prizmanın yüksekliğinin 3 katıdır. Dolayısıyla hacimleri eşittir.
$V_{Piramit} = 150 \text{ cm}^3$

3 puan – hem bağıntı doğru, hem de $V_{Piramit} = V_{Prizma}$ eşitliği kurulabilmişse,
2 puan – bağıntı doğru ancak $V_{Piramit} = V_{Prizma}$ eşitliği kurulamamışsa,
1 puan – bağıntıda hata yapılmışsa,
0 puan – bağıntı yoksa ya da tamamen yanlışsa

(3 puan) 9) Tabanı kürenin en büyük dairesi olan ve tepesi kürenin üzerinde olan en büyük koninin hacmi 27 cm^3 tür. Bu koniyi içeren kürenin hacmi kaç cm^3 tür?



h = r = koninin yüksekliği
$V_{Koni} = (3.\ r^2.\ r\ ) / 3 = 8$
r = 2 cm

$V_{Küre} = 4/3.\ 3.8 = 32 \text{ cm}^3$

3 puan – formüller, işlemler ve cevap doğru ise
2 puan – formül doğru, h = r doğru ama sonuca giden işlem yanlışsa
1 puan – formül doğru ancak h = r bağıntısı bulunamadıysa
0 puan – formüller yanlış ya da yoksa

(3 puan) 10a) r= 5 cm., h= 8 cm.
Yukarıdaki verileri kullanarak dik koni ile ilgili şekil çiziniz.

3 puan – şekil doğru, veriler şekil üzerinde doğru yerleştirilmişse,
2 puan – şekil doğru, veriler şekil üzerinde yanlış yerleştirilmişse,
1 puan – şekil doğru, veriler yerleştirilmemişse,
0 puan – şekil yoksa ya da yanlışsa

(3 puan) 10b) r= 5 cm., h= 8 cm.
Yukarıdaki verileri kullanarak **dik koninin hacmi** ile ilgili bir problem kurunuz.

Örnek cevap: Şekildeki koni şeklindeki dondurma külahının taban yarıçapı 5 cm, yüksekliği 8 cm ise hacmi kaç cm^3 tür?

3 puan – tüm veriler doğru kullanılarak bir soru yazılmışsa, 2 puan – bazı veriler doğru kullanılarak bir soru yazılmışsa, 1 puan – problem yazmadan sadece "r=5 cm, h=8 cm, ise V=?" yazılmışsa, 0 puan – problem yazılmamışsa ya da tamamen yanlışsa

(3 puan) 10c) r= 5 cm., h= 8 cm.
Yukarıdaki verileri kullanarak **dik piramidin hacmi** ile ilgili kurulan problemi çözünüz. (Π=3)

Örnek cevap : V = (Taban alanı x yükseklik) / 3 = $(\Pi.r^2.h)/3$
$V = (3.5^2.\ 8) / 3 = 200\ cm^3$

3 puan – formül doğru, işlem doğru ve cevap doğru ise, 2 puan – formül doğru, işlem doğru ancak sonuç hatalı bulunduysa, 1 puan – formül doğru ancak işlemler hatalıysa, 0 puan – formül yanlış ya da cevap yoksa

(3 puan) 11a) portakal, 6cm., yarıçap, hacim verilerini kullanarak küre ile ilgili bir problem kurunuz.

Örnek cevap:Yarıçapı 16 cm olan küre şeklindeki bir portakalın hacmi kaç cm^3 tür? (Π =3)

3 puan – tüm veriler doğru kullanılarak bir soru yazılmışsa, 2 puan – bazı veriler doğru kullanılarak bir soru yazılmışsa, 1 puan – problem yazmadan sadece "r=6 cm ise V=?" yazılmışsa, 0 puan – problem yazılmamışsa ya da tamamen yanlışsa

11b) portakal, 6cm., yarıçap, hacim verilerini kullanarak küre ile ilgili kurulan problemi çözünüz.

Örnek cevap : $V = (4/3.\ \Pi.\ r^3) = (4/3.\ 3.\ 6^3) = 4.\ 512 = 864\ cm^3$

3 puan – formül doğru, işlem doğru ve cevap doğru ise, 2 puan – formül doğru, işlem doğru ancak sonuç hatalı bulunduysa, 1 puan – formül doğru ancak işlemler hatalıysa, 0 puan – formül yanlış ya da cevap yoksa

APPENDIX L: OBJECTIVES INCLUDED IN 6^{th}, 7^{th} and 8^{th} GRADE TEXT BOOKS WHICH ARE RELATED WITH VOLUME OF PYRAMIDS, CONE AND SPHERE

6^{th} grade

Name of the Unit: Geometric Objects

- Students will determine the main elements of prisms.

Name of the Unit: Measurement/ Volume of Geometric Shapes

- Students will develop formulas about the volumes of rectangular prism, square prism and cube.
- Students will make predictions abut the volumes of rectangular prism, square prism and cube.
- Students will solve and built problems abut the volumes of rectangular prism, square prism and cube.
- Students will explain the units about measurement of volumes and convert the units to each other.

7^{th} grade

Name of the Unit: Measurement/ Volume of Geometric Shapes

- Students will make predictions abut the volume of right circular cylinder and develop the formula about the volume of it.
- Students will solve and built problems abut the volume of right circular cylinder.

8^{th} grade

Name of the Unit: Measurement/ Volume of Geometric Shapes

- Students will develop formulas about the volume of right prisms.
- Students will develop formulas about the volume of right pyramids.
- Students will develop formulas about the volume of right circular cone.
- Students will develop formulas about the volume of sphere.
- Students will solve and built problems abut the volumes of geometric objects.
- Students will make predictions about the volumes of geometric objects by using strategy.

APPENDIX M: TEST OF NORMALITY

Table M. 1. Test of normality of School-1 and School-2

		Group	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
			Statistic	Df	Sig.	Statistic	df	Sig.
SCHOOL-1	TVpre-Part2	Experimental Group	,168	33	,019	,906	33	,008
		Control Group	,111	30	,200*	,959	30	,300
	TVpre-Part3	Experimental Group	,132	33	,155	,946	33	,100
		Control Group	,186	30	,010	,914	30	,019
	TVpre	Experimental Group	,110	33	,200*	,958	33	,232
		Control Group	,133	30	,189	,952	30	,195
	TVpost	Experimental Group	,133	33	,149	,964	33	,331
		Control Group	,155	30	,063	,925	30	,037
	Mathematics Self-efficacy Scale as pretest	Experimental Group	,113	33	,200*	,940	33	,070
		Control Group	,127	30	,200*	,961	30	,322
	Mathematics Self-efficacy Scale as posttest	Experimental Group	,106	33	,200*	,949	33	,120
		Control Group	,150	30	,082	,922	30	,031
SCHOOL-2	TVpre-Part2	Experimental Group	,129	35	,150	,952	35	,127
		Control Group	,133	33	,149	,964	33	,342
	TVpre-Part3	Experimental Group	,108	35	,200*	,974	35	,547
		Control Group	,113	33	,200*	,962	33	,300
	TVpre	Experimental Group	,111	35	,200*	,970	35	,453
		Control Group	,150	33	,058	,942	33	,077
	TVpost	Experimental Group	,154	35	,035	,937	35	,044
		Control Group	,119	33	,200*	,969	33	,450
	Mathematics Self-efficacy Scale as pretest	Experimental Group	,127	35	,165	,952	35	,132
		Control Group	,111	33	,200*	,962	33	,285
	Mathematics Self-efficacy Scale as posttest	Experimental Group	,106	35	,200*	,936	35	,041
		Control Group	,119	33	,200*	,958	33	,229

REFERENCES

Amy, L. Z., L. B. Shari and P. Frank, 2006, "A Comparative Study of the Self-Efficacy Beliefs of Successful Men and Women in Mathematics, Science, and Technology Careers", *Journal of Research in Science Teaching*, Vol. 45, No. 9, pp. 1036-1058.

Arcavi,A. and M. Isoda, 2007, "Learning to Listen: from Historical Sources to Classroom Practice", *Educ Stud Math,* Vol. 66, pp. 111-129.

Aşık, G., 2009, *A Model Study to Examıne The Relatıonshıp Between Metacognıtıve And Motıvatıonal Regulatıon And Metacognıtıve Experıences Durıng Problem Solvıng in Mathematıcs,* M.S. Thesis, Bogazici University, İstanbul, Turkey.

Aydın, N. and Ş. Beşer, 2009, *İlköğretim Matematik 8 Ders Kitabı*, Aydın Yayıncılık ve Eğitim Hizmetleri LTD. ŞTİ., Ankara.

Aygün, S. Ç., N. Aynur, N. Coşkuntürk, S. S. Çüha, U. Karaman, U. Özçelik, M. Ulubay and N. Ünsal, 2009, *Öğretmen Kılavuz Kitabı Matematik 8*, İhlas Gazetecilik A.Ş. MEB Devlet Kitapları, İstanbul.

Ayotola, A. and T. Adedeji, 2009**, "**The Relationship between Mathematics Self-efficacy and Achievement in Mathematics", *Procedia - Social and Behavioral Sciences,* Vol. 1, No. 1, pp. 953-957.

Awosanya, A., 2001, *Using History in the Teaching of Mathematics,* Ph.D. Dissertation, Florida State University, United States.

Bandura, A., 1977, "Self-efficacy: Toward a Unifiying Theory of Behavioral Change", *Psychological Review*, Vol. 84, pp. 191-215.

Bandura, A., 1994, "Self-efficacy", in V. S. Ramachaudran (ed.), *Encyclopedia of human behavior*, Vol. 4, pp. 71-81, Academic Press, New York.

Bandura, A., 1995, *Self-efficacy in Changing Societies*, Cambridge University Pres.

Bandura, A., 1997, *Self-efficacy : The Exercise of Control*, pp. 526-573, W.H. Freeman, New York.

Betz, N. E. and G. Hackett, 1987, "Concept of Agency in Educational and Career Development", *Journal of Counseling Psychology*, Vol. 34, No. 3, pp. 299.

Bıkmaz, F. H., 2004, "Sınıf Öğretmenlerinin Fen Öğretiminde Öz Yeterlilik İnancı Ölçeğinin Geçerlik Ve Güvenirlik Çalışması", *Milli Eğitim Dergisi*, Vol. 161, http://yayim.meb.gov.tr/dergiler/161/bikmaz.htm

Bidwell, J. K., 1993, "Humanize your Classroom with History of Mathematics", *Mathematics Teacher*, Vol. 86, No. 6, pp. 61-64.

Bunt, L.N., P.S. Jones and J.D. Bedient, 1988, *The Historical Roots of Elemetary Mathematics,* Dover Publications, New York.

Carter, D. B., 2006, *The Role of The History of Mathematics in Middle School*, M.S. Thesis, East Tennessee State University, United States.

Chen, P. P., 2002, "Exploring the Accuracy and Predictability of the Self-efficacy Beliefs of Seventh-grade Mathematics Students", *Learning and Individual Differences*, Vol. 14, No. 1, pp. 77-90.

Cooke, R., 1997, *The History of Mathematics: A Brief Course,* A Wiley-Interscience, United States of America.

Creswell, J. W., 2003, *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*, SAGE Publications, Thousand Oaks, London, New Delhi.

Cuomo, S., 2001, *Ancient Mathematics*, Taylor and Francis Group, London and New York.

Devis, P. J. and R. Hersh, 2002, *Matematiğin Seyir Defteri,* Doruk Yayımcılık, Ankara.

Dönmez, A., 1986, *Bir Bilim Olarak Matematik Tarihi,* V Yayınları, Ankara.

Elçi, A. N., 2002, *Ortaöğretim Matematik Öğretiminde Öğretmen Davranışlarının Başarıya Etkisi,* M.S. Thesis, Dokuz Eylül University, İzmir, Turkey.

Erktin, E.and E. Ader, 2004, "Üniversite Öğrenci Seçme Sınavı Fen Ve Matematik Başarısında Duyuşsal Değişkenlerin Rolü", *VI. Ulusal Fen Bilimleri Ve Matematik Eğitimi Kongresi*, 9-11 September 2004, pp. 238, İstanbul.

Farmaki, V., N. Klaoudatos and T. Paschos, 2004, "Integrating the History of Mathematics in Educational Praxis: An Euclidean geometry approach to the solution of motion problems", *28th Conference of the International Group for the Psychology of Mathematics Education*, Vol. 3, pp. 505-512.

Fauvel, J. and J. Maanen, 1997, "The Role of the History of Mathematics in the Teaching and Learning of Mathematics Discussion Document for an ICMI Study (1997–2000)", *ZDM*, Vol. 29, No. 4, pp. 138-140.

Fleming, K. K., 1998, *The Effect of Self-efficacy, Gender, Self-concept, Anxiety, and Prior Experience on a Model of Mathematics Performance*, Ph.D. Dissertation, University of Kansas.

Friberg, J., 2007, *Amazing Traces of a Babylonian Origin in Greek Mathematics*, World Scientific Publishing, Singapore.

Fried M. N., 2001, "Can Mathematics Education and History of Mathematics Coexist?", *Science & Education*, Vol. 10, pp. 391-408.

Fried, M. N., 2007, "Didactics and History of Mathematics: Knowledge and Self-knowledge", *Educational Studies in Mathematics,* Vol. 66, No. 2, pp. 203-223.

Fried, M. S., 2008, "History of Mathematics in Mathematics Education: a Saussurean Perspective", *The Montana Mathematics Enthusiast*, Vol. 5, pp. 185-198.

Furinghetti, F., 2000, "The Long Tradition of History in Mathematics Teaching: An Old Italian Case" in V. Katz, (ed.), *Using History to Teach Mathematics: An International Perspective 2000,* pp. 29-35, The Mathematical Association of America, Washington, DC.

Furinghetti, F., 2007, "Teacher Education through the History of Mathematics", *Educational Studies in Mathematics*, Vol. 66, pp. 131–143.

Fuson, K. C., M. Kalchman and J. D. Brandsford, 2005, "Mathematical Understanding: An Introduction" in M. S. Danovan and J. D. Brandsford (eds.), *How Students Learn-History, Mathematics and Science in the Classroom,* The National Academic Pres, Washington, D.C.

Gaskill P. M. and A. H. Woolfolk, 2002, *Improving Academic Achievement – Impact of Psychological Factors on Education*, Elsevier Science, USA.

Gay, L. R., G. E. Mills and P. Airasian, 2006, *Educational Research*, Pearson Prentice Hall, Upper Saddle River.

Georgiou, I., 2006, *Ethnomathematics and the History of Mathematics in Mathematics Class; the WHY and the HOW***,** M.S. Thesis, Warwick University.

Glasersfeld, E. von, 1991, "A Constructivist View of Learning and Teaching" in R. Duit, F. Goldberg and H. Niedderer (eds.), *Research in physics learning: Theoretical issues and empirical studies - Proceedings of an international workshop*, pp. 29–39, Kiel, Germany: IPN.

Goodwin, D. M., 2007, *Exploring the Relationship Between High School Teachers' Mathematics History Knowledge and their Images of Mathematics,* Ph.D. Dissertation, University of Massachusetts, Lowell.

Göğün, Y., 2008, *Matematik 6 Ders Kitabı*, Özgün Matbaacılık Sanayi ve Ticaret A.Ş, Ankara.

Gönülateş, F. O., 2004, *Prospective Teachers' Views on the Integration of History of Mathematics in Mathematics Courses,* M.S. Thesis, Bogazici University, İstanbul, Turkey.

Graham, L. H., 2000, *Self-efficacy, Motivation Constructs, and Mathematics Performance of Middle School Students: A Three-year Longitudinal Study*, Ph.D. Dissertation, Emory University.

Grugnetti, L., 2000, "History of Mathematics and Its Influence on Pedagogical Problems" in V. Katz, (ed.), *Using History to Teach Mathematics: An International Perspective 2000,* pp. 29-35, The Mathematical Association of America, Washington, DC.

Heiede, T., 1996, "History of Mathematics and the Teacher" in R. Calinger, (ed.), *Vita Mathematica: Historical Research and Integration with Teaching*, pp. 231-243, The Mathematical Association of America.

Horng, W., 2000, "Euclid versus Liu Hiu: A Pedagogical Reflection" in V. Katz, (ed.), *Using History to Teach Mathematics: An International Perspective 2000,* pp. 37-46, The Mathematical Association of America, Washington, DC.

IEA, 2009, *TIMMS & PIRLS International Study Center,* Lynch School of Education, Boston Collage, http://timss.bc.edu

İdikut, N., 2007, *Matematik Öğretiminde Tarihten Yararlanmanın Öğrencilerin Matematiğe Yönelik Tutumlarına ve Matematik Başarılarına Etkisi,* M.S. Thesis, Yüzüncü Yıl University, Van, Turkey.

İnci, İ., 2009, *İlköğretim Matematik 7 Ders Kitabı*, Evrensel İletişim Yayınları, Ankara.

Jankvist, U. T., 2009, "A Categorization of the "Whys" and "Hows" of Using History in Mathematics Education", *Educational Studies in Mathematics,* Vol. 71, No. 3, pp. 235-261.

Karaduman, G. B., 2010, "A Sample Study for Classroom Teachers Addressing the Importance of Utilizing History of Math in Math Education"**,** *Procedia - Social and Behavioral Sciences*, Vol. *2,* No. *2*, pp. *2689-2693.*

Karakuş, F., 2009, "Matematik Tarihinin Matematik Öğretiminde Kullanılması: Karekök Hesaplamada Babil Metodu", *Necatibey Faculty of Education Electronic Journal of Science and Mathematics Education*, Vol. 3, No. 1, pp. 195-206.

Kiamanesh, A. R., E. Hejazi and Z. N. Esfahani, 2004, *The Role of Math Self-Efficacy, Math Self-Concept, Perceived Usefulness of Mathematics and Math Anxiety in Math Achievement*,http://www.self.ox.ac.uk/Conferences/2004_Kiamanesh_Hejazi_Esfahani.pdf

Kiremit, H. Ö., 2006, *Fen Bilgisi Öğretmenliği Öğrencilerinin Biyoloji İle İlgili Öz-Yeterlik İnançlarının Karşılaştırılması***,** Ph.D. Dissertation, Dokuz Eylül University.

Kleiner, I., 1996, "History-of-Mathematics Course for Teachers, Based on Great Quotations" in R. Calinger, (ed.), *Vita Mathematica: Historical Research and Integration with Teaching,* pp. 261-268, The Mathematical Association of America.

Liu, P., 2003, "Do Teachers Need to Incorporate the History of Mathematics in their Teaching?", *The Mathematics Teacher,* Vol. 96, No. 6; pp. 416.

Marshall, G. L., 2000, *Using History of Mathematics to Improve Secondary Students' Attitudes Towards Mathematics,* Ph.D. Thesis, Illinois State University.

Man-Keung, S., 2000, “The ABCD of Using History of Mathematics in the (undergraduate) Classroom”, in V. Katz (ed.), *Using History to Teach Mathematics: An International Perspective 2000,* pp. 3-9, The Mathematical Association of America, Washington, DC.

MEB, 2009, *İlköğretim Matematik Dersi 6-8. Sınıflar Öğretim Programı ve Klavuzu,* http://ttkb.meb.gov.tr/ogretmen/modules.php?name=Downloads&d_op=viewdownlo ad&cid=48

method of exhaustion, 2010, http://www.britannica.com/EBchecked/topic/198052/method-of-exhaustion

Mısır Piramitleri, 2011, http://en.wikipedia.org/wiki/Psychology

Michaelides, M. P., 2008, “Emerging Themes from Early Research on Self-efficacy Beliefs in School Mathematics”, *Electronic Journal of Research of Educational Psychology*, Vol. 6, No. 1, pp. 219-234.

Migray, K., 2002, *The Relationships among Math Self-efficacy, Academic Self-concept, and Math Achievement*, Ph.D. dissertation, Arizona State University.

Moore, N. M., 2005, *Constructivisim Using Group Work and The Impact on Self-Efficacy, Intrinsic Motivation and Group Work Skills on Middle School Mathematics Students,* Ph.D. Dissertation, Capella University.

MSP (Middle School Portal), 2009, *Connections Math History as a Teaching and Learning Tool,*http://wiki.nsdl.org/index.php/MSP:MiddleSchoolPortal/Connections:_Math_History_as_a_Teaching_and_Learning_Tool

National Research Council, 2001, *Adding It Up: Helping Children Learn Mathematics*, in J. Kilpatrick, J. Swafford, and B. Findell (eds.), Center for Education. National Academy Press, Washington, DC.

Nazlıçiçek, N. and E. Erktin, 2002, "İlköğretim Matematik Öğretmenleri İçin Kısaltılmış Matematik Tutum Ölçeği", *Paper presented at V.Ulusal Fen Bilimleri ve Matematik Eğitimi Kongresi*, Ankara, http://www.fedu.metu.edu.tr/UFBMEK-5/b_kitabi/PDF/Matematik/Poster/t194.pdf

NCTM (National Council of Mathematics), 2000, *Principles and standards for school mathematics,* NCTM, Reston, Va.

NCTM (National Council of Mathematics), 1998, *Historical Topics for the Mathematics Classroom*, Reston Publishing, Reston, VA.

Nicolaou, A. and G. Philippou, 2007, "Efficacy beliefs, problem posing, and mathematics achievement", *Focus on Learning Problems in Mathematics,* http://findarticles.com/p/articles/mi_m0NVC/is_4_29/ai_n24248332/

OECD, 2004, *Learning for tomorrow's world. First results from PISA 2003,* Organization for Economic Co-operation and Development, Paris.

OECD, 2009, *What Students Know and Can Do: Student Performance in Reading, Mathematics and Science*, PISA 2009 Results: Executive Summary, http://www.oecd.org/dataoecd/54/12/46643496.pdf

Özyürek, R., 2010, "The Reliability and Validity of the Mathematics Self-Efficacy Informative Sources Scale", *Kuram ve Uygulamada Egitim Bilimleri,* Vol. 10, No. 1, pp. 439-447.

Pajares, M. N., 1993, *Mathematics self-efficacy as a mediating mechanism on mathematics problem-solving performance: A path analysis*, Ph.D. Dissertation, University Florida, AAT 9505626.

Philippou, G.N. and C. Christou, 1998, “The Effects of a Preparatory Mathematics Program in Changing Prospective Teachers’ Attitudes towards Mathematics”, *Educational Studies in Mathematics,* Vol. 35, pp. 189–206.

Reimer, L. and W. Reimer, 1990, *Mathematicians Are People, too*, Dale Seymour Publication, USA.

Sassano, J. B., 1999, *The Design and Evaluation of Mathematics History Materials for Pre-Service Elementary Teachers,* Ed.D. Dissertation, Columbia University Teachers College, United States, New York.

Savizi, B., 2006, “Applicable Problems in the History of Mathematics: Practical Examples”, *Teaching Mathematics and its Applications,* Vol. 26, No. 1.

Scholz, U., B. G. Dona, A. Sud and R. Schwarzer, 2002, “Is General Self-efficacy a Universal Construct?”, *European Journal of Psychological Assessment,* Vol. 18, No. 3, pp. 242-251.

Sertöz, A. S., 1994, “Arşimed’in Küreleri”, *Matematik Dünyası*, Vol. 4, pp. 1-3.

Snyder, C. R. and S. J. Lopez, 2002, *Handbook of Positive Psychology*, Oxford University Press, New York.

Stevens, T., A. Olivarez and D. Hamman, 2006, “The Role of Cognition, Motivation, and Emotion in Explaining the Mathematics Achievement Gap Between Hispanic and White Students”, *Hispanic Journal of Behavioral Sciences*, Vol. 28, No. 2.

Struik, D. J., 2002, *Kısa Matematik Tarihi,* Doruk Yayıncılık, İstanbul.

Swetz, F., 2000, “Mathematical Pedagogy: an Historical Perspective” in V. Katz (ed), *Using History to Teach Mathematics: An International Perspective 2000,* pp. 11-16, The Mathematical Association of America, Washington, DC.

Tara, S., O. Arturo and H. Doug, 2006, "The Role of Cognition, Motivation, and Emotion in Explaining the Mathematics Achievement Gap between Hispanic and White Students", *Hispanic Journal of Behavioral Sciences*, Vol. 28, No. 2, pp. 161-186.

Terzi, M. and Ş. Mirasyedioğlu, 2009, "Analysis Of Department Of Elemantary Mathematics Teaching Students' Perceived Mathematics Self- Efficacy In Terms Of Some Variables", *Tübav Bilim Dergisi,* Vol. 2, No. 2, pp. 257-265.

Tez, Z., 2008, *Matematiğin Kültürel Tarihi*, Doruk Yayımcılık, İstanbul.

Tözlüyurt, E., 2008, *Sayılar Öğrenme Alanı ile İlgili Matematik Tarihinden Seçilen Etkinliklerle Yapılan Dersler Hakkında Lise Son Sınıf Öğrencilerinin Görüşleri.* M.S. Thesis, Gazi University, Ankara, Turkey.

Turgut, M. and S. Yılmaz, 2007, "Geometri Derslerine Nasıl Giriş Yapardık? İlköğretim Matematik Öğretmen Adaylarının Görüşleri", *Bilim, Eğitim ve Düşünce Dergisi,* Vol. 7, http://www.universite-toplum.org/text.php3?id=334

Tzanakis, C., 2000, "Presenting the Relation between Mathematics and Physics on the Basis of their History: A Genetic Approach", in V. Katz (ed), *Using History to Teach Mathematics: An International Perspective 2000,* pp. 111-120, The Mathematical Association of America, Washington, DC.

Tzanakis, C. and A. Arcavi, 2000, "Integrating History of Mathematics in the Classroom: An Analytic Survey", in J. Fauvel and J. Van Maanen (eds), *History in Mathematics Education*, pp. 201-240, Kluver Academic Publishers, Netherland.

Umay, A, 2001, *İlköğretim Matematik Öğretmenliği Programının Matematiğe Karşı Özyeterlik Algısına Etkisi*, http://www.fedu.metu.edu.tr/ufbmek5/b_kitabi/PDF/OgretmenYetistirme/Bildiri/t311DA.pdf

Ülger A., 2006, *Matematiğin Kısa Bir Tarihi*, Türkiye Bilimler Akademisi, Ankara.

Usher, E. L. and F. Pajares, 2006, "Sources of Academic and Self-regulatory Efficacy Beliefs of Entering Middle School Students", *Contemporary Educational Psychology*, Vol. 31, pp. 125–141, http://www.elsevier.com/locate/cedpsych

Usher, E. L., 2009, "Sources of Middle School Students' Self-Efficacy in Mathematics: A Qualitative Investigation", *American Educational Research Journal*, Vol. 46, No. 1, pp. 275-314.

Uzar, F. N., 2010, *İlköğretim Öğrencilerinin Matematik Dersine Yönelik Öz-Yeterliğini Besleyen Kaynakların Farklı Değişkenlere Göre İncelenmesi*, Ph.D. Dissertation, Hacettepe University.

Yevdokimov, O., 2004, "A View on Active Learning in Mathematics through Historical Context", *An International Conference to Review Research on Science, Technology and Mathematics Education*, pp. 99-101, http://www.hbcse.tifr.res.in/episteme-1/allabs/oleksiy_abs.pdf

Yevdokimov, O., 2006, "Using Materials from the History of Mathematics in Discovery-based Learning", *ICME-10 Satellite Meeting of the International Study Group on the Relations between the History and Pedagogy of Mathematics and 4th European Summer University on History and Epistemology in Mathematics Education*, 12-17 Jul 2004, Uppsala, Sweden, http://eprints.usq.edu.au/3353/1/Yevdokimov_2004-6_ICME10.pdf

Yevdokimov, O., 2007, "Using the History of Mathematics for Mentoring Giftes Students: Notes for Teachers", *Paper Presented at 21st Biennial Conference of the Australian Association of Mathematics Teachers Inc.*, Hobart, Australia.

Zarch, M. K. and P. Kadivar, 2006, "The Role of Mathematics Self-efficacy and Mathematics Ability in the Structural Model of Mathematics Performance", *Proceedings of the 9th WSEAS International Conference on Applied Mathematics*, Istanbul, Turkey, 27-29 May 2006, pp. 242-249.

Zientek, L. and B. Thompson, 2010, "Using Commonality Analysis to Quantify Contributions that Self-Efficacy and Motivational Factors Make in Mathematics Performance", *Research in the Schools,* Vol. 17, No. 1, pp. 1-11.

Zimmerman, B. Z., 2002, "Self-efficacy: An Essential Motive to Learn", *Contemporary Educational Psychology*, Vol. 25, No. 1, pp. 82-91.